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13 June 1985

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

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AUSTRALIA

ACTING FOREIGN MINISTER DEPLORES LATEST FRENCH TEST

BK101213 Melbourne Overseas Service in English 0830 GMT 10 May 85

[Text] The acting foreign minister, Senator Evans, said today he deplored the latest French nuclear test at Mururoa Atoll in the Pacific Ocean. The test, believed to be the biggest undertaken since the French began testing there 10 years ago, had an estimated yield of 150 kilotons.

Senator Evans said Australia was extremely concerned at the size of the latest test, adding there was no justification for continued testing, especially of that magnitude. He said Australia would continue to do all it could to seek an end to all nuclear testing by all states through the early conclusion of comprehensive test ban treaty.

CSO: 5100/4306

FRENCH POLONESIA

BRIEFS

NUCLEAR TEST--Wellington, May 1 (AFP)--France today exploded a one kilotonne nuclear device at its underground testing site at Mururao Atoll in the South Pacific, a New Zealand Government seismological station reported. The monitoring station at Rarotonga in the Cook Islands detected the blast at 0529 NZ Time Wednesday (1729 GMT April 30). The underground test was the first French blast reported this year. The New Zealand Government, experienced in reading underground test patterns from their seismic recorders, were confident that the test had occurred, a spokesman said. He said this was a later start to French testing than in previous years and predicted there would be several more tests over the next few weeks. France has exploded more than 60 nuclear devices underground at Mururoa in the past decade. They have ranged in yield from 1 kilotonne to 140 kilotonnes, according to New Zealand records. [Text] [Hong Kong AFP in English 0659 GMT 1 May 85]

CSO: 5100/4304

JAPAN

JAPAN, U.S. FAIL TO AGREE ON N-WASTE REPROCESSING

OW211135 Tokyo KYODO in English 1106 GMT 21 May 85

[Text] Tokyo, 21 May (KYODO)--Japan and the United States Tuesday ended two days of talks with no agreement on revising the bilateral atomic energy agreement enabling Japan to reprocess nuclear waste under advance package U.S. approval, Japanese officials reported.

The next meeting, the 12th of the kind, will be held in the United States at the end of July.

The two countries have been holding the atomic energy talks under an agreement reached at the 1981 Japan-U.S. summit meeting between President Ronald Reagan and then Prime Minister Zenko Suzuki.

Under the current atomic energy agreement, Japan needs specific prior U.S. approval every time it is going to reprocess nuclear waste in Japan. Japan hopes to employ a package approval formula.

Talks on the revision of the agreement have met rough going as the United States wants to add new regulations on uranium enrichment and plutonium processing to the accord under the 1978 nuclear nonproliferation treaty.

CSO: 5100/4523

ANTINUCLEAR GROUP SEEKS RECONCILIATION WITH PRC

OW221235 Tokyo KYODO in English 1113 GMT 22 May 85

[Text] Tokyo, 22 May (KYODO)--A Japanese communist-organized anti-nuclear organization said Wednesday it plans to send a representative to China for the first time in 20 years.

The trip, scheduled for early June, is regarded as a step toward reconciliation between the ideologically divided communist parties of Japan and China.

Hajime Tanuma, leader of the Japan Council Against Atomic and Hydrogen Bombs (GENSUIKYO), told a news conference Wednesday the organization will be represented at an international forum for peace to be held in Beijing 4-6 June.

He said Koichi Akamatsu, secretary-general of GENSUIKYO, will attend the conference, which is being organized by the Chinese Association of International Exchanges.

GENSUIKYO has dissociated itself from China's peace movement since 1966, due to an ideological dispute between the two communist parties.

Tanuma said GENSUIKYO decided to participate in the forum after officials of the Chinese sponsor pointed out that it was created in 1981 and was not involved in the dispute.

"It is significant that China is returning to the international peace movement and we approve of the conference's objective," Tanuma said.

About 100 representatives will be invited to attend the forum. Tokuma Utsunomiya, an Upper House member, and five other members of another Japanese pacifist group will also be among them.

CSO: 5100/4523

JAPAN

JAPAN COMPLETES OWN EXPERIMENTAL N-SEPARATOR

OW231323 Tokyo KYODO in English 1243 GMT 23 May 85

[Text] Tokaimura, Ibaraki Pref, 23 May (KYODO)--Japan has completed its own experimental nuclear separator for uranium enrichment which is 30 times more efficient than the conventional models, the semigovernmental developer said Thursday.

The Power Reactor and Nuclear Fuel Development Corp (DONEN) disclosed to the public for the first time the centrifugal separator, which it said marks a step toward domestic uranium enrichment for Japan now completely dependent on other countries.

The separator will be installed at DONEN's prototype uranium enrichment plant to be built in Ningyo Pass in Okayama Prefecture, as well as at a similar, but commercial plant to be constructed in Rokkashomura, Aomori Prefecture, by the electric power industry, the DONEN officials said.

The officials said two billion yen was spent to develop the separator which can run continuously for at least 10 years and whose higher efficiency will make it possible to reduce the plant size to about 40 percent of the conventional facilities.

The DONEN's vessel containing 16 separators measures about 1.5 meters in diameter and about three meters in height, compared with some 30 centimeters and two meters, respectively for those now in use, the officials said.

CSO: 5100/4523

JAPAN

FBR STEAM GENERATOR DEVELOPMENT TRENDS DESCRIBED

Tokyo GENSHIRYOKU KOGYO in Japanese Jan 85 pp 64-72

[Article by Tohru Fukuda, Manager of the System Design Development Room, the Fast Breeder Reactor Unit Development Division, Oharai Engineering Center, Power Reactor & Nuclear Fuel Development Corporation: "The Latest Trend of the Technological Development of Fast Breeder Reactors (3) - Steam Generators"]

[Text] 1. Introduction

Important component units of liquid-metal cooled fast breeder reactors of atomic power plants include the steam generators that perform the function of conducting heat from liquid metal to water. Their development has been a significant task in more than 30 years' history of fast breeder reactors (FBR). Therein the good balance between reliability and economy has been pursued in the course of increasing unit capacity. In this connection, various nations are continuing the development of steam generators with reasonable mechanisms for preventing water leakage from heat conducting tubes or minimizing its influences. Those of the atomic reactors now in operation could be said to considerably differ from that of the first experimental fast reactor that reached criticality in Britain in 1959.

The following conferences were held during the last year or so:

(1) IAEA Specialist Conference on the Soundness and Reliability of Steam Generators (Hague: November, 1983)

(2) IAEA Specialist Conference on the Maintenance and Repair of Steam Generators (Oharai: June, 1984)

(3) International Conference on Liquid Metal (Oxford: April, 1984)

(The meetings will be abbreviated as the Hague, Oharai and Oxford Conferences respectively hereunder.)

The Hague and Oharai Conferences dealt with the soundness and reliability of steam generators in connection with the sodium and water interaction caused by the latter's water leakage, and its detection, and with the experiences in

water leakage and the technological development of maintenance and repair measures respectively. The following are the quotations from the conferences' "Conclusions and Recommendations."

(1) Further study is necessary as to the improvement in reliability and performances of steam generators. In this connection it is beneficial to pay attention to the various causes and phases of troubles.

(2) Priority is being given to maintenance and repair considerations in designing the steam generators for liquid-metal cooled FBRs.

(3) As far as we have been informed, all the cases of water leakage from liquid-metal cooled FBRs have occurred at welds. Increased attention should be paid to the decrease of welds, their quality, the inspection techniques applied to them and their behaviors in actual plants.

The papers read on steam generators at Oxford Conference are divided as follows in connection with subcommittee meetings.

Water leak behaviors: 8 papers
Water leak detection: 7 papers
Steam generator test: 11 papers
(Two deal with repairs after water leakage occurred.)

The discussions at the conferences suggested various nations' latest trends in the development of steam generators.

The past and present development of steam generators has been collectively published by Tsuchiya et al. This paper will therefore introduce various nations' latest trends of development of steam generators chiefly in connection with the papers read at the conferences.

2. Experiences in Operating Steam Generators

Since the start of the operation of BN-350 in the USSR in 1972, the prototype FRBs that have continued operation so far include the French Phoenix and three British PFRs and their steam generators have recorded more than 50,000 hours of operation. In the meanwhile valuable experiences have been accumulated in the repair of water leaks from heat conducting tubes and tubesheets.

France:

Since reaching criticality in August, 1973, Phoenix has served as forerunner among the breeders in operation. Its steam generator had the first water leak at a reheater on April 29, 1982, followed by that on December 16, the same year and February 15 and March 20 the next year. All the three groups of its steam generators consist of an evaporator, a superheater and a reheater (Table 1) of which each has 12 modules and has a hair-pin type structure (Figure 2). The former two and latter's running time amounted to 52,000 and 47,000 hours respectively until water leak.

Table 1. Various Nations' Steam Generators

国 (a)	DeBeNe				フランス（イタリー）(b)				イギリス (c)			アメリカ (d)		ソ連 (e)					日本 (f)	
(1) プラント	SNR-300				Phenix			SPX-1	PFR			CRBR		BN 350		BN 600			もんじゅ	
(2) 蒸気出力 (MW)	327				250			1200	250			375		350		600			280	
(3) 熱出力 (MW)	770				568			3000	600			975		1000		1470			714	
(4) 蒸気条件	16.5MPa×495℃				16.3MPa×510℃			17.7MPa 487℃	15.96MPa×538℃			10.5MPa×485℃		5.1MPa×430℃		14.2MPa×505℃			12.5MPa×483℃	
(5) ループ数	2		1		3			4	3			3		6（内予備1）(6)		3			3	
(7) 構成	EV	SH	EV	SH	EV	SH	RH	—	EV	SH**	RH**	EV	SH	EV	SH	EV	SH	RH	EV	SH
(8) 基数/ループ	3	3	3	3	12	12	12	1	1	1	1	2	1	2	2	8	8	8	1	1
(9) 伝熱管本数/基	211	211	77	77	7	7 (11)	7	357	498	520	448	757	757 (12)	(13)					150	150
(10) 型式	ST	ST	HC	HC	ヘアピン	ヘアピン	ヘアピン	HC	U	U	U	ホッケースティック	ホッケースティック	バイヨネット	U	ST	ST	ST	HC	HC
(14) 伝熱管材料	2¼Cr* 1Mo	同	同	同	2¼Cr 1Mo Nb	SUS 321	SUS 321	Alloy 800	2¼Cr 1Mo Nb	SUS 316	SUS 316	2¼Cr 1Mo	2¼Cr 1Mo	2¼Cr 1Mo	2¼Cr 1Mo	パーライト鋼 (15)	オーステナイト鋼 (16)	オーステナイト鋼	2¼Cr 1Mo	SUS 321
(17) 設計の動向	SNR 2 直管型又はヘリカルコイル型のいずれかを検討中 単基容量450MW以上ならヘリカルコイル型，以下なら直管型が有効と評価 (18)				SPX 2 本案 ヘリカルコイル型 Alloy 800 代替案（イタリーが担当） 直管型 9Cr-2Mo鋼 (19)				CDFR J型 一体貫流型 2基/ループ 9Cr-1Mo鋼 (20)			大型炉 ホッケースティック型 (21) ヘリカルコイル型 二重管型 で設計研究がすすめられている。							実証炉 ヘリカルコイル型 で検討がすすめられている。 (22)	
(23) モックアップテストの実績 （ ）の数字は熱出力 (MW)	50MW Sodium Component Test Facility 直管型 EV (26) 3,300hrs SH (17) 12,000hrs RH (7) 100hrs ヘリカルコイル型 EV (55) 13,800hrs (24)				45MW Test Loop (CGVS) Phenix 13,000hrs EV(30) SH(10) RH(7) SPX-1 ヘリカルコイル型 18,460hrs EV(33) SH(12) 直管型 45MW, 5,200hrs SPX 2（イタリーが担当） 直管型 4,800hrs EV(33) SH(10) (25)				テスト・ループなし (26) ** PFR取替用SH, RH SH(伝熱管 264本) RH(伝熱管 216本) 9Cr-1Mo鋼 (28)			70MW SCTI CRBR ホッケースティック型テスト終了 計画中 ヘリカルコイル型 二重管型 (27)		BOR 60でモックアップテスト実施 BN-600用 EV+SH (25) 10,000hrs マイクロモジュール型 EV+SH (30) 32,000hrs インバース型 EV+SH (30) 10,800hrs （1983年末現在） (29)					50MWテストループ もんじゅ用 （1号機） EV (40) SH (10) 3,500hrs もんじゅ用 （2号機） EV (40) SH (10) 14,000hrs （実施中） (30)	

* Stabilized

(31) HC：ヘリカルコイル　ST：直管

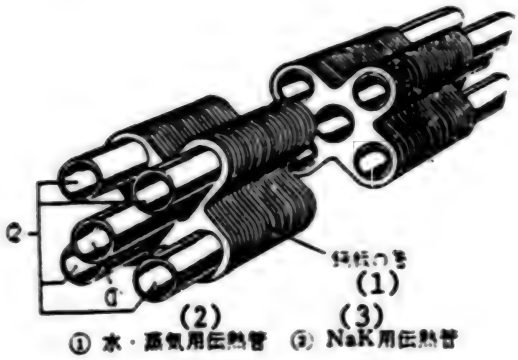
(a) Nations (b) France and Italy (c) Britain (d) United States (e) USSR (f) Japan

[Key continued on following page]

[Key continued]

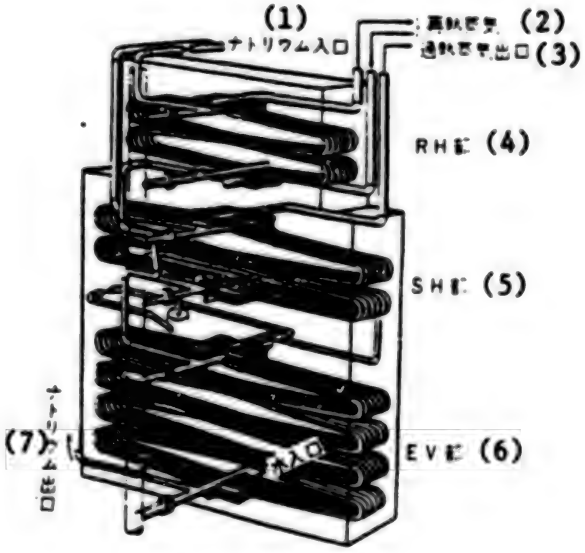
(1) Plants
(2) Electric Output
(3) Thermal output
(4) Steam conditions
(5) Quantity of leaps
(6) 6 (including one spare leap)
(7) Construction
(8) Quantity of units/loop
(9) Quantity of heat conducting tubes/unit
(10) Type
(11) Hair-pin
(12) Hockey stick
(13) Bayonet
(14) Heat conducting tube material
(15) Pearlite steel
(16) Austenite steel
(17) Trend of design
(18) SNR-2: Which of straight tube and helical coil types should be selected is under study. The latter or former is regarded as effective for unit capacities of, respectively, more or less than 450 mW.
(19) SPX-2: Plan--helical coil type, Alloy 800 Alternative (planned by Italy) --straight tube type, 9Cr-2Mo steel
(20) CDRF: J-type, combined through-flow type, 2 units/loop 9Cr-1Mo steel
(21) Large-sized reactor: Hockey stick, helical coil and duplex tube types are under design study.
(22) Demonstration reactor: Helical coil type is under study.
(23) Results of mock-up test--parenthesized numerals represent thermal output (mW).
(24) 50mW sodium component test facility: straight tube type--evaporator (26 units) 3,300 hours, superheater (17 units) 12,000 hours, reheater (7 units) 100 hours, helical coil type--evaporator (55 units) 13,800 hours.
(25) 45mW test loop (CGVS) Phoenix 13,000 hours. Evaporator (30 units), superheater (10 units), reheater (7 units)
SPX-1: helical coil type 18,460 hours, evaporator (33 units), superheater (12 units), straight tube type 45 mW 5,200 hours.
SPX-2 (planned by Italy): Straight tube type 1,800 hours, evaporator (33 units), superheater (10 units)
(26) No test loop provided
(27) 70 mW SCTI CRBR: The test of hockey stick type completed.
Planned: helical coil type, duplex tube tupe
(28) **The superheaters, reheaters and superheaters (264 heat conducting tubes), reheaters (216 heat conducting tubes), 9Cr-1Mo steel
(29) BOR-60 used for mock-up test. For BN-600: evaporator + superheater (25 units), 10,000 hours. Micromodule type: evaporator + superheater (30 units) 32,000 hours. Inverse type: evaporator + superheater (30 units) 10,800 hours. (as of late in 1983)
(30) 50mW test loop For Monju (No. 1): evaporator (40 units, superheater (10 units), 3,500 hours. For Monju (No. 2): evaporator (40 units), superheater (10 units, 14,000 hours (plan being carried out)
(31) Helical coil ST: straight pipe

Figure 1. Steam Generator of Dornray Experimental Reactor



Key: (1) copper plate layer
(2) (1) Water-steam heat conducting tube
(3) NaK heat conducting tube

Figure 2. Steam Generator of Phoenix



Key: (1) Sodium inlet
(2) Reheated steam outlet
(3) Superheated steam outlet
(4) Reheater
(5) Superheater
(6) Evaporator
(7) Sodium outlet

The above cases of water leaks were detected by the sodium-hydrogen-content gauges immediately after occurring, and water-side pressure reduction and drainage were carried out to prevent its increase. At first, however, considerable time was spent before starting the measures, so wear occurred to adjacent heat conducting tubes and body sides.

The following were the location and times of water leak:

(1) 1st time: No 2 steam generator No 12 module
2nd time: No 1 steam generator No 12 module
3rd time: No 3 steam generator No 12 module
4th time: No 1 steam generator No 11 module

(2) The butt-welds of the high-temperature heat conducting tubes near the sodium inlets.

(3) Between the 1st and 5th days after restarting operation.

In investigating the causes, it was estimated that a small amount of water caused a considerable thermal stress--low-cycle thermal fatigue--near thickness increasing welds. As a result, the reheaters of all the groups were replaced with newly-manufactured ones.

The advantages of module construction have been emphasized because only two weeks were necessary for the process consisting of the occurrence and location of water leak, the purification of sodium and the restart of operation. Their influence was such that operation was shut down for 268 rated output days.

Britain:

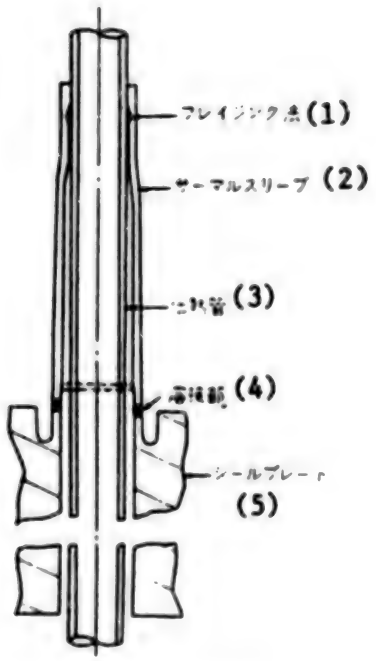
The steam generators of the three loops of PFRs have frequently caused water leaks since the start of water supply in October, 1974. Each generator consists of an evaporator, a superheater and a reheater (Table 1). Of these, two evaporators, two superheaters and one reheater had leaks and the reheater was removed early in 1976.

The superheaters have continued operation steadily after the repair of the heat conducting tubes by explosive bonding method. In parallel therewith, however, studies have been carried out as to the design of the superheaters and reheaters for replacement until it was decided to manufacture their tube bundles from 9Cr-1Mo steel. The first reheater manufactured was installed in place of that removed. The remaining two reheaters and three superheaters were also manufactured from 9Cr-1Mo. They are planned to be used for replacement when necessary. The tube bundles for replacement are of thermal sleeve type, not of tubesheet weld type (Figure 3).

The two evaporators were also repaired by explosive bonding method. Although no water leak occurred for a while thereafter, all evaporators underwent repair after 1980. To cope with this, the sleeve method (Figure 4) was introduced in place of explosive bonding method. To prevent water leaks, its application

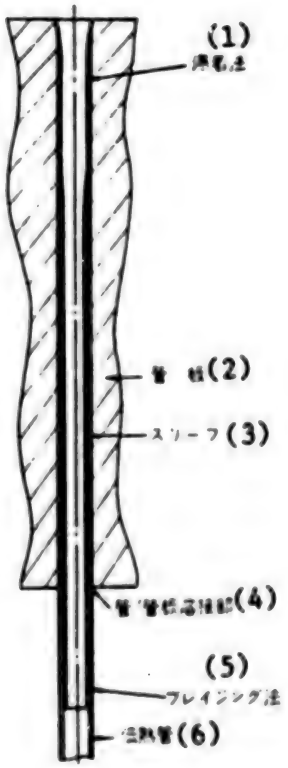
to all--a total of about 3,000--heat conducting tubes of the three evaporators was accomplished during the latter half of 1984. Sleeves were inserted into the heat conducting tubes to cover their welds to the tubesheets, with their upper and lower ends welded to them and the tubes by explosive and brazing methods, respectively, using 9Cr-1Mo steel.

Figure 3. Thermal Sleeve System (PFR - Superheaters and Reheaters for Replacement)



Key:
(1) Brazing method
(2) Thermal sleeve
(3) Heat conducting tube
(4) Weld
(5) Seal plate

Figure 4. Sleeve Method Repair (PFR, EU)



Key:
(1) Explosive bonding method
(2) Tubesheet
(3) Sleeve
(4) Tube-tubesheet weld
(5) Brazing method
(6) Heat conducting tube

All cases of water leak are located at the welds between heat conducting tubes and tubesheets. They are estimated to come from the progress of defects, i.e., alkali stress corrosion cracks (CSCC) by sodium-water reaction products. It is thought that they may originate in improper welding or manufacture methods. It is considered that an enormous amount of money and labor has been spent for the countermeasures to the loss of generated power due to water leak, its location, the investigation of causes, repair and so forth.

USSR:

BN-350 had leakage eight times during the period ranging from the reach of criticality in 1972 to 1975. Three thereof were of large scale. It was estimated that they came from the entry of several hundred kilograms of water into the sodium so a number of heat conducting tubes failed. Water leakage was observed at five of the six loops of the evaporators and in all cases were located at welds. It is estimated that they came from improper welds during manufacture. The heat conducting tubes with a thickness of 2mm of the five loops of evaporators were replaced with 3mm ones.

3. Trend of Technological Development

Various efforts of technological development have been underway to improve the reliability of steam generators in all the nations concerned.

Design Consideration:

In Europe, in designing steam generators, a maximum of one heat conducting tube is assumed to have failed and to have broken instantaneously and completely in the initial stages of water leakage. In Japan, on the other hand, initial failure is assumed to occur when a total of four adjacent heat conducting tubes break, of which a maximum of one breaks instantaneously and completely. However, all the nations commonly recognize that efforts should be made to minimize water leakage scale in the reasonable design and development of large-scale steam generators and water detecting systems.

Quantity of steam generators:

Unit and module systems are used. The former and latter employ one steam generator and a plurality thereof respectively per component unit. The merits and demerits of their costs (manufacture, space, etc.), operation (leak location, repair, etc.) and other features are evaluated and various nations employ a unique construction system for each atomic reactor (see Table 1). When water leakage occurs, the following are ensured to secure the operation factors suitable for each system of plants.

(1) Unit system: leak location, repair range investigation and repair can quickly be carried out with plants kept running.

(2) Module system: water leaking modules are quickly replaced with spare ones.

Location of water-leaking heat conducting tubes:

Since the one steam generator employs several hundred heat-conducting tubes, a considereable time is necessary for locating water-leaking ones. Various nations are tackling the problem of how to locate them. The method introduced for Super-Phoenix 1 (SPX-1), France, will be introduced hereunder (Figures 5 and 6).

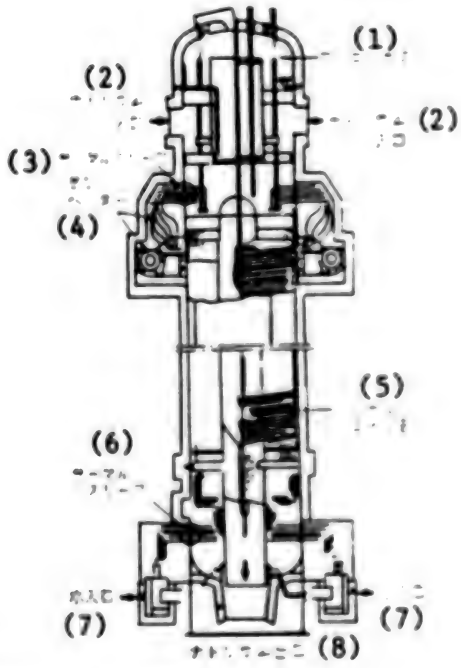
(1) Both the inlet- and outlet-side ones of 357 heat conducting tubes are separated into four parts, further into 16 groups, for their interconnection. The groups containing water-leaking heat conducting tubes can be located by applying pressure with filled nitrogen gas.

(3) The 360° angle of the sodium-side part of helical-coil heat conducting tubes are divided into eight sections by support structures. Each of these sections is provided with a sampling tube for detecting hydrogen. When nitrogen gas is supplied to water-leaking tube groups by the above methods, water-leaking sections can be located in view of its flow.

(3) When the level of sodium liquid is raised or lowered, the nitrogen gas flow sound is monitored using an acoustic detector, and the scale of the water leak can be fixed in view of its variation.

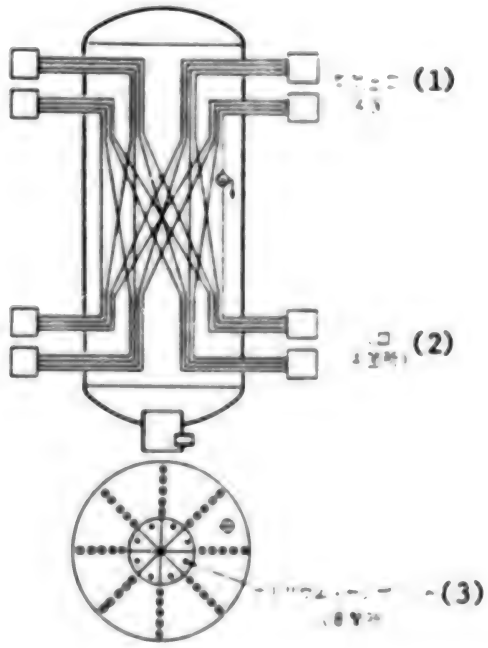
(4) Leak detection range is narrowed using a computer with the above three data. Water-leaking heat detecting tubes can be finally specified by supplying hydrogen gas to the heat-conducting tubes one by one.

Figure 5. Steam Generator of SPX-1



Key: (1) Argon gas
(2) Sodium inlet
(3) Thermal sleeve
(4) Steam header
(5) Helical coil
(6) Thermal sleeve
(7) Water inlet
(8) Sodium outlet

Figure 6. Schematic Drawing of the Location of SPX-1 Water Leaking Heat Conducting Tubes



Key: (1) steam outlet (x4)
(2) Water inlet (x4)
(3) Sodium sampling (x8)

Equipment is installed to ensure the above steps without opening steam generators. When the nitrogen gas has a considerably different temperature than the steam generators, that of the tubesheet part of water-leaking heat conducting tubes varies. The method for locating them utilizing this phenomenon is under study.

Development of materials:

In various nations, a wide range of steam generators are manufactured from reliable materials, 2-1/4Cr-1Mo and SUS steels. They are carrying out the development of their materials to further improve reliability. France has adopted ALLOY 800 for the heat conducting tubes of SPX-1 and Britain 9Cr-1Mo steel for those for replacement of superheaters and reheaters. Besides various nations are designing and studying the steam generators made of new materials including 9Cr-2Mo and 12Cr steels.

Development of inspection techniques:

Various nations are studying the improvement of ultrasonic and eddy-current flow detection techniques for heat conducting tubes. They are considered as indispensable for judging whether the inspection and repair of the wear loss in adjacent heat conducting tubes is necessary in cases of water leakage and they plan to raise their detection speed and sensitivity.

Development of repair methods:

Various nations are carrying out the development of both-end plugging methods (welding and explosive-bonding) for repairing water-leaking heat conducting tubes.

Development of water leak detectors:

The sodium and cover-gas hydrogen gauges with nickel film have been placed into practical use among water leak detectors. Their durability and stability are to be further improved.

Lately various nations are making efforts to develop acoustic detectors. They are expected to be useful for the early detection and location of water leaks. Development tests are underway with them attached to the steam generators of actual plants and the mock-up ones of test loops and their detection performance is evaluated with simulated water leaks.

Countermeasures to pressure waves:

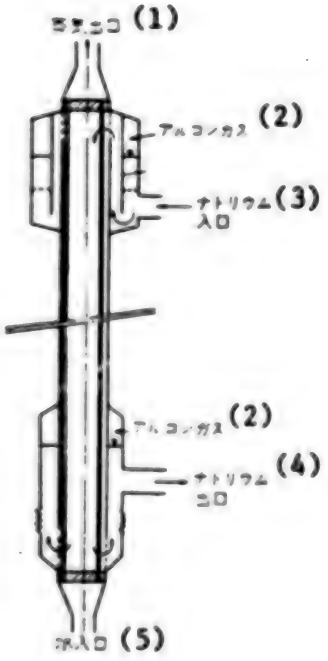
The merits and demerits of the cover gas spaces at the inner sodium side part of steam generators are under study in various aspects. Therein their function of reducing the increase of sodium-water interaction pressure is appreciated. In designing SNR-2 and CDFR, they are planned to be provided near the sodium outlet and inlet of steam generators to reduce the propagation of pressure in the tubes and units of the secondary system (Figure 7).

Duplex heat conducting tubes:

The idea of preventing the defects in heat conducting tubes, as the direct result of sodium-water interaction, by making them duplex has been under study

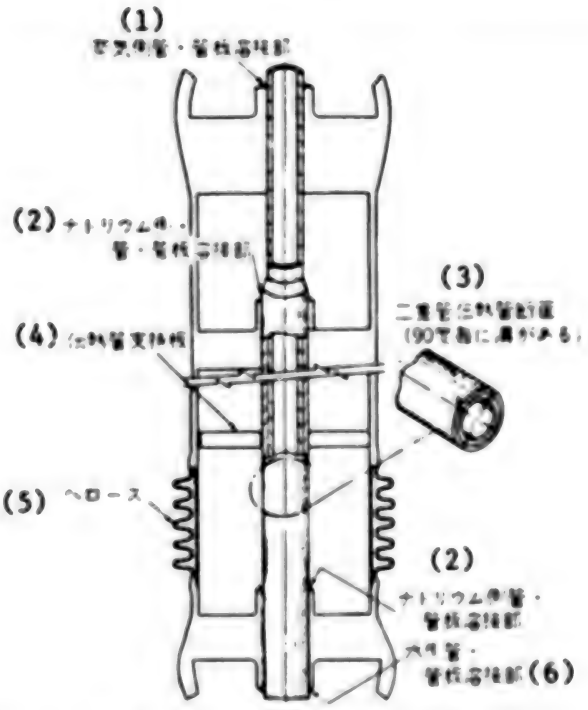
since shortly after the development of fast breeder reactors. In the United States, it has been adopted for the steam generators of experimental reactors and the FBR II still uses the steam generators with duplex heat conducting tubes; the plan for large-scale reactors is under study and mock-ups are being manufactured for 70mW tests. The first paper of this series noted that the employment of duplex heat conducting tubes is under examination in the research for designing large-scale reactors (Figure 8).

Figure 7. Steam Generator of SNR-2 (plan)



Key:
(1) Steam generator
(2) Argon gas
(3) Sodium inlet
(4) Sodium outlet
(5) Water inlet

Figure 8. Conceptual Drawing of Duplex Heat Conducting Tube Steam Generators



Key:
(1) Steam side tube - tubesheet weld
(2) Sodium-side tube - tubesheet weld
(3) Section of duplex heat conducting tube (grooves provided at 90° intervals
(4) Heat conducting tube support plate
(5) Bellows
(6) Water side tube - tubesheet weld

Recently a study is being made in various nations to omit the secondary cooling system by adopting steam generators with duplex heat conducting tubes.

Inverse type steam generators:

An inverse type steam generator in which sodium and water are supplied to the inside of the heat conducting tubes and the body side has been developed and a 30mW mock-up has been installed and tested for an experimental reactor BOR-60 (Figure 9). It is mentioned among the features of the steam generators of this type that there is a low probability of defective heat conducting tubes causing wear to adjacent ones even when sodium-water interaction occurs. It is also pointed out that their increase in size is difficult.

4. Nations' Trend of the Development of Steam Generators

The trend of the steam generators for prototype and demonstrating reactors as well as for mock-up test and large-reactor design and research will be discussed hereunder (see Table 1).

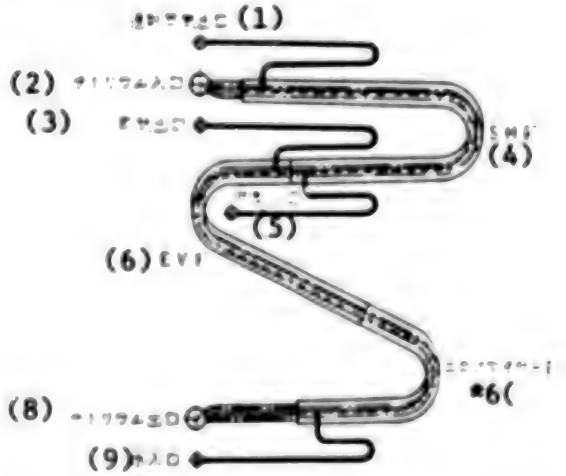
DeBeNe

SNR-300: Loops employ straight tube and helical coil types. One loop of evaporators (55mW) and superheaters (30mW) consists of three modules.

SNR-2: The employment of either straight tube or helical coil combined flow through type is planned. However, it has not been decided which of them to select although the former or latter is suitable for unit capacities of, respectively, more or less than 450mW.

Figure 9. Inverse Type Steam Generator

Key: (1) Superheated steam outlet
(2) Sodium inlet
(3) Steam outlet
(4) Superheater
(5) Steam inlet
(6) Evaporator
(7) Economizer
(8) Sodium outlet
(9) Water inlet



For the 50mW test loop (SCTF), both straight tube and helical coil types underwent mock-up tests.

France and Italy:

Phoenix is a hair-pin module type, consisting of 12 evaporators, 12 superheaters and 12 reheaters per loop. SPX-1 is a combined flow-through type, employing one 750mW unit per loop. It is made from ALLOY 800. SPX-2 is originally planned to be made of helical coil type. Its module type alternative under study however employs the straight tubes developed in Italy.

For 45mW test loop (CGVS), tests have been underway as to the mock-ups for Phoenix, the helical coil and straight tube type ones for SPX-1 and the straight tube type ones developed for SPX-2 in Italy.

Britain: PFR is planned to consist of an evaporator, a superheater and a reheater all of U-type per loop, and CDFR is planned of combined straight-flow type consisting of two 450mW J-type straight tubes per loop. They are planned to be manufactured from the same material, 9Cr-1Mo steel, as the superheaters and reheaters for replacement of PFRs.

Britain has no steam generator testing loop. A plan for testing the DCFR mock-ups attached to PFR is, however, under study.

USSR:

BN-350 and BN-600 are of module and straight tube module types, consisting of two evaporators (81mW bayonet type) and two superheaters (19mW U-type), and of eight evaporators (41mW), eight superheaters (11mW) and eight reheaters (9mW), respectively. In studying steam generator systems, the module type was considered as suitable for about more than 1,000 mW plants.

The USSR has no steam generator testing loop. Mock-up tests are underway for the experimental fast reactor BOR-60. Tests have hitherto been underway as to the mock-ups for BN-600 as well as the micromodule and inverse type ones manufactured in Czechoslovaklia.

Japan:

"Monju" is of a separate flow-through helical coil type, consisting of an evaporator and a superheater per loop. A 50mW testing loop has been used to test its mock-ups. Nos 1 and 2 mock-ups have continued operation for 3,400 and 14,000 hours (still in operation) respectively. They have demonstrated constant performances and soundness, showing no water leakage at all, during a long period.

Among large-scale reactor steam generators, helical type ones are chiefly under study from various angles.

In this connection the following are observed:

(1) All the nations concerned attach importance to the test of 50mW-class mock-ups.

(2) Britain and the USSR are not carrying out a test for the steam generator mock-ups of PFRs and BN-350s. In these nations, water leakage has occured since the initial stage of operation.

(3) All the nations concerned do not always increase the steam generator systems of prototype reactors in size for large-scale reactors. They are carrying out the development of various devices for the same purpose.

(4) For the steam generators of large-scale reactors, mock-up tests are carried out prior to their design to reflect its results.

(5) Conclusion

Needless to say, the development of plant component units generally involves both the basic elucidation of principles and the establishment of manufacturing technologies.

The latter requires the accumulation of actual manufacturing experiences. Those in manufacturing full-size mock-ups are valuable and those in their long-period operation supply useful information. International information exchange is significant for supplementing domestic ones.

Sodium-water interaction is very significant among the phenomena to be theoretically elucidated in the course of the development of steam generators. Further development and study efforts are necessary for cost saving and their improvement in reliability in the course of their increase in size. Various nations are busy in this direction. At the Hague Conference, it was confirmed that in future experiments actual steam generator conditions should be simulated if possible to avoid excessively-pessimistic results.

The early detection and location of water leaks are necessary for the increase in size of steam generators. In this direction, a new type water leak detector is expected to make its debut. Epoch-making ideas are anticipated to be worked out in view of the trend of the development of a wide range of new technologies in general industrial sectors.

At the Hague and Oharai Conferences, it was recommended to hold a conference on "Economic and Reliable Design for LMF BR Steam Generators" with a number of expert participants in 1987. What developmental results would various nations' representatives report there?

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CSO: 4106/875-T

NUCLEAR EXPORT LOAN GUIDELINES

Tokyo GENSHIRYOKU KOGYO in Japanese Jan 85 p 72

[Text] Needless to say, financial conditions are significant for collecting the orders for the export of atomic power plants. The guidelines agreed to by the 22 participant nations of OECD (except Turkey and Iceland) came into force on August 10, 1984.

The guidelines apply to high-interest currencies such as U.S. dollars, French francs and so forth, not to Japanese yen, the Netherlands' guilders, West German marks, Swiss francs or Austrian schillings.

Accordingly, the value of the nations import and export banks' minimum financial interest for the export of atomic power plants was fixed at that of a general gentlemen's agreement of minimum interests enforced on July 15, 1984, plus one percent, and the maximum term of payment was stretched to 15 years.

The items of the export include atomic power plants, as well as their component units and parts, the fuels for first charge and two fuel replacements and operators' training, but exclude the formalities and so forth for licensing and authorization for which the importing nations are responsible.

The purpose of the guideline is to regulate the tendency toward international financial interest damping competition for exporting atomic power plants with a background of a decrease of the advanced nations' chances for collecting orders. Mr Regan, the U.S. Secretary of Treasury, expressed his welcome of the guideline and mentioned among the reasons for the welcome that a one percent decrease in interests enables 200 million dollars to be saved during the whole term of repayment since atomic power plants require a large amount of capital.

What effects would be exerted by the guideline?

It is said to be not necessary for West Germany--a comparable atomic power plant export nation to the U.S. and France--and Japan, which is expected to place stress on the export of atomic power plants, to follow the guideline because of their low interest rates. At present, in the case of low interest rate currencies, the interest rate for the export of atomic power plants is fixed by adding 0.1 percent to long-term prime rate. It is lower by several percents than that of the guideline. The U.S. and France reportedly regard it to serve to their disadvantages. Some of those concerned, on the other hand, consider

the same for West Germany and Japan for the reason that it requires the addition of 0.1 percent to their lower prime rate than open market rate.

Japan proposed in the conference in which the guideline was agreed that it should not apply to Taishan Atomic Power Plant, China, and the nation's trades with Canada, Turkey and Egypt for which agreements had already been concluded. This, as well as the trend of liberalizing finances, would require the nation to take a careful attitude toward it.

The nations concerned in the London Guideline also held a conference at Luxemburg last July on the nuclear non-proliferation problem that is important in a different sense from financial interest in the export of atomic power plants. It is necessary to pay attention to this aspect.

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CSO: 4106/875-T

EXECUTIVE SAYS NO COMMERCIALLY VIABLE URANIUM RESERVES

HK131546 Manila BUSINESS DAY in English 13 May 85 p 2

[Text] The country does not have commercially viable uranium reserves, contrary to claims of proponents of the Bataan nuclear plant project, a mining executive said.

Luisito B. Albarracin, Benguet Corporation vice-president for exploration, said it is true that Benguet and Getty Oil have found traces of uranium within the old Philippine Iron Mines area in Camarines Norte during their exploration work conducted in 1979 to 1981. However, the uranium mineralization is erratic at best and occurs only within narrow zones which means potential tonnage is limited, he pointed out.

Albarracin said the indicated grade of the narrow zones is only 0.005 percent uranium, which is much too low and, therefore, not commercially viable. He said such grade is barely one-tenth to one-twentieth of that of most of the existing uranium mines in the world.

Because of poor results, he said, Benguet and Getty discontinued exploration work and turned over the area to the Bureau of Energy Development (BED) sometime in 1981. He also said similar results were also found by another company in Negros.

Energy Minister Geronimo Z. Velasco last 25 March at the Kapihan sa Maynila [Manila Coffeeshop] forum claimed that Benguet Corporation and Getty Oil have found minable uranium. The Ministry of Energy (MOE) likewise treats uranium energy as an indigenous source in their statistics, notwithstanding the fact that the uranium that will be used for the nuclear plant will come in processed form from foreign, particularly U.S.-controlled sources. Recently, a newspaper columnist (not writing for BUSINESS DAY) claimed that the Philippines has the fourth largest uranium deposit in the world.

CSO: 5100/4307

VISITING ROMANIAN PRESIDENT DISCUSSES NUCLEAR DEVELOPMENT

Hopes for Cooperation

Toronto THE GLOBE AND MAIL in English 13 Apr 85 p B9

[Article by David Stewart-Patterson]

[Text] OTTAWA — A Romanian decision to expand its nuclear energy program could mean more business for the beleaguered Canadian nuclear industry, according to Romanian officials.

The Communist Party Congress in November decided to increase the number of power stations it will build and to accelerate their construction. Romania now plans to raise its nuclear generating capacity to 12,000 megawatts by 1993.

Atomic Energy of Canada Ltd. has a contract for two 600-megawatt Candu reactors that are now under construction and Export Development Corp. has enough financing approved to pay for two more.

The officials said only 3,000 megawatts of the planned nuclear capacity will be built with technology from the Soviet Union. The other 9,000 megawatts of capacity will conform to the Candu design, which uses natural rather than enriched uranium as fuel.

The 1978 and 1981 deals between Canada and Romania were intended to result in a transfer of technology that would eventually allow Romania to build its own Candu reactors. Romania must pay a royalty for the first 15 reactors it builds.

Romania would like to absorb all the technology, but although the Canadian content in the third and fourth units would be lower than that in the first two, there should be plenty of room for further Canadian exports.

Indeed, if the two countries can agree to specialize in different parts of the reactor, Romania will probably still be buying Canadian equipment by the time it builds its tenth reactor, a senior official said.

Romania is also interested in co-operating with Canada in selling Candu reactors in other countries, and officials suggested that its help could be particularly useful in Communist countries and others with which Romania has good relations.

Nuclear co-operation will be one of the topics on the agenda for Romanian President Nicolae Ceausescu as he begins a four-day Canadian visit tomorrow.

Although the first two Candu deals have been marked by Romanian demands that Canadian suppliers accept Romanian goods instead of cash, officials said Romania is philosophically opposed to countertrade practices.

However, Romania also wants to keep its bilateral trade in balance, and admits it has a shortage of hard currency to pay for expensive imports such as nuclear reactors.

As a result, the $200-million in contracts awarded to Canadian suppliers last year have been matched by agreements to take $200-million worth of Romanian goods in lieu of cash over the next six or seven years.

In the future, Romania wants to sell more manufactured goods to Canada, including cars, tractors, electrical equipment, machine tools, clothing and footwear. What it wants from Canada are raw materials such as uranium, coal, mineral ores and asbestos.

In 1984, Canada exported $23-million worth of goods to Romania, including $11-million worth of turbines and $8-million worth of sulphur. It imported $47-million worth of Romanian goods, with clothing, aluminum and tractors heading the list.

Protocol Signing

Ottawa THE CITIZEN in English 17 Apr 85 p A14

[Excerpt]

Romanian President Nicolae Ceausescu spoke hopefully Tuesday of prospects his country could do $1 billion worth of business a year with Canada by the end of the century.

Prime Minister Brian Mulroney said that was "an excellent target," even though trade between the two countries now is worth about $70 million annually, senior government officials told reporters.

The officials, speaking on the condition they not be named, said the higher trade figures would be that much easier to reach if Romania bought further nuclear equipment and technology and signed long-term mineral contracts Ceausescu and his entourage discussed with Canadian officials this week.

Ceausescu, in this country on a four-day official visit, signed a protocol with Atomic Energy of Canada Ltd. Tuesday, which Canadian officials interpret as providing for broader Canadian participation in the construction of Romanian nuclear reactors.

Romania is the only country where Candu nuclear reactors are still under construction but the Romanian government has been trying to phase out foreign participation

so it can become self-sufficient in constructing its reactors.

Ceausescu cut short his visit by one day when a tour of the Pickering nuclear generating plant near Toronto couldn't be arranged because of labor and security problems.

The Toronto leg of the trip was dropped but a tour of the Gentilly generating station on the banks of the St. Lawrence River near Trois-Rivieres, Que., has been substituted.

Ceausescu tours the 600-megawatt Candu reactor today.

The officials said Ceausescu invited Mulroney and his wife, Mila, to visit Romania and while the prime minister said he would like to make the trip he did not indicate a date.

Visit to Gentilly Plant

Toronto THE GLOBE AND MAIL in English 18 Apr 85 p 4

[Text]

TROIS-RIVIERES, Que. (CP) — Romanian President Nicolae Ceausescu, unable to visit the Pickering nuclear power plant east of Toronto, finally got a glimpse of Canadian nuclear technology with a tour of the nearby Gentilly II power station.

Wearing protective boots and a coat and accompanied by his wife, Elena, Mr. Ceausescu took a relaxed tour yesterday of Hydro-Quebec's nuclear power station in Bécancour, halfway between Montreal and Quebec City.

Later yesterday, the Romanian leader was hustled into a downtown Montreal hotel for a luncheon as about 60 demonstrators, most of them Canadians of Hungarian origin, chanted "Ceausescu assassin" over what they claim is the "cultural genocide" of 2.5 million Hungarians living in Romania.

The Gentilly plant with a Canadian Candu reactor is similar to a nuclear plant being built in Romania, the only country where Candu reactors are under construction. Five units are being built in the Communist nation with contracts signed for two more units worth $350-million and prospects of another worth $100-million.

Mr. Ceausescu, on the final day of his four-day visit to Canada, listened attentively but asked no questions as hydro officials explained the operation of the $1.5-billion facility, which produces 675 megawatts of electricity.

Robert Layton, Minister of State for Mines, accompanied the Romanian President and said the visit was designed to show off Canada's industrial know-how.

Radioactive Dust Problem

Toronto THE GLOBE AND MAIL in English 22 Apr 85 p 3

[Article by Thomas Claridge]

[Text]

Problems with radioactive Carbon-14 dust have halted progress on the retubing of two Pickering Generating Station reactors and were an undisclosed factor in Ontario

Hydro's decision to cancel a planned station tour by Romanian dignitaries.

Kenneth Talbot, the Hydro official in charge of the $700-million retubing for Pickering's Unit 1 and 2 reactors, said no pressure-tube sections have been removed from the reactors since March 21, when workers withdrew service on grounds that contamination problems caused by the dust had not been resolved.

Meanwhile, another Hydro official acknowledged that radiation-monitoring required to deal with the Carbon-14 problem was partly responsible for a decision to cancel a planned tour of the Pickering station last Tuesday by an entourage headed by Romanian President Nicholae Ceausescu.

Michael Williams, assistant to the director of Hydro's nuclear generation division, said it would have been impractical to subject the 75-member entourage to monitoring with hand-held radiation detectors.

CSO: 5120/17

CANADA

STUDIES COMPLETED FOR TWO NEW RESEARCH REACTORS

Toronto THE GLOBE AND MAIL in English 12 Apr 85 p B17

[Article by Robert Kozak]

[Text]

Atomic Energy of Canada Ltd. is developing nuclear reactors to replace its outdated NRX research reactor and at the same time allow the Crown corporation to get a foot into the nuclear doors of developing countries.

Preliminary engineering studies are completed and approved for two research reactors called Maple 10 and Maple 20, while procurement funds and final approval for construction are expected within two months.

Construction of an operational prototype will then begin and take approximately three years.

Development teams assembled in 1983 have designed "a primary research tool for AECL for use in the 1990s as well as simultaneously providing an updated research tool for the international market," according to an AECL research scientist.

The result has been Maple 10, a one-megawatt to 10-megawatt reactor, and another that will produce between 10 megawatts and 20 megawatts called Maple 20.

Development working parties at AECL's White Shell Nuclear Research Establishment at Pinawa, Man., and Chalk River, Ont., have joined forces with a business opportunity working party at AECL's head office in Ottawa.

Their positive assessment for sales of the Maples resulted in formation of a business opportunities team to find world markets.

"There are leads and we are in the process of selling the Maples at the design stage," said Denis St. Jean, corporate spokesman for the Maples team.

AECL plans to break into markets from which it has previously been excluded and to establish a clientele for the much larger power-producing Candu reactors.

Both Maples will run on a 20 per cent enriched uranium fuel in a core that sits in eight to 10 metres of light-water coolant that also acts as a biological shield.

The Maple 20 is also known as Maple X, because it will replace the 40-year-old NRX reactor presently at Chalk River, Ont.

Both Maples are adaptations of AECL's Slowpoke 2 research reactor technology and simplifications of the basic NRX concept, according to an AECL background paper.

The Maple 10 is aimed at countries with limited nuclear installations, such as Algeria, Egypt, Australia, and New Zealand.

The International Atomic Energy Agency has recommended to the governments of Uruguay and Colombia that they start their nuclear programs with small research reactors.

The Maple 20 is aimed at countries that have had reactors in operation within the last 20 years.

There are about 250 operating research reactors around the world, with the major developers being the United States, the Soviet Union, and various western European countries.

CSO: 5120/17

'EVENTS' AT GENTILLY II REACTOR SINCE INCEPTION REVEALED

Windsor THE WINDSOR STAR in English 23 Apr 85 p C6

[Text]

MONTREAL (CP) — About 20 "abnormal or unusual events" have taken place at the Gentilly II nuclear reactor since it began producing electricity for Hydro-Quebec in 1982.

While defects at Ontario Hydro reactors become immediate public issues, the Montreal daily Le Devoir said Monday it tracked down Gentilly II malfunctions through Atomic Energy of Canada Ltd. documents in Ottawa and in interviews.

Antoine Duchesne, head of support services at Gentilly II, said the incidents — described as "events" in nuclear jargon — "had an importance of extreme variation which, because of the rules, had to be reported to the (Atomic Energy) Control Commission.

DESPITE ITS sophisticated operating system, the Hydro-Quebec plant — situated on the St. Lawrence River halfway between Montreal and Quebec City — had its share of human errors.

Of six "events" between October 1982 and May 1984 reported to the Atomic Energy Control Commission, five were caused by human error. Three also fell into a category of events which, under the plant's operating permit, must be reported when a breakdown could "constitute a risk for the health and security of the public or personnel of the plant or increase the probability of such a risk."

CSO: 5120/17

CANADA

SASKATCHEWAN URANIUM MINE PRODUCTION DISCUSSED

Toronto THE GLOBE AND MAIL in English 3 Apr 85 p B22

[Text]

KEY LAKE, Sask. — In this remote outpost 600 miles north of the U.S.-Canadian border, there appears to be little besides sub-zero cold, driving snow, the odd moose and the much more numerous ravens.

But underground there is uranium, enough to fuel every U.S. nuclear reactor for more than five years. Even the boulders on the ground and the needles of the black spruce are radioactive.

"Just make a note," said Josef Spross, operations manager for the giant uranium mine here, as he pointed to a large outcropping of steel-grey rock. "This is the richest uranium mine in the world."

It also is one of the few with a huge customer base — and thus, a seemingly guaranteed future. Last year, for the first time, Canada leaped ahead of the United States to become the largest producer of uranium, supplying a third of the world's needs.

Despite an international glut that has reduced worldwide uranium mining to 70 per cent of capacity, Canada has found export markets for 85 per cent of its output. The richness of Canada's ores makes it the undisputed low-cost producer of uranium, and the country is expected to hold on to its leadership spot.

"Nobody has the ability to compete toe to toe with the Canadians," said a U.S. trade association official.

Indeed, Canada's uranium output has risen from 17.7 million pounds in 1979 to 29.1 million pounds last year — nearly twice U.S. output.

That has been quite a blow to such U.S. corporate giants as Kerr-McGee Corp. of Oklahoma City, Standard Oil Co. of Ohio, Cleveland, Phelps Dodge Corp. of New York and Union Carbide Corp. of Danbury, Conn. Enthusiastically anticipating a booming market, U.S. companies invested millions of dollars in the development of uranium mines in the 1970s, only to watch the price of uranium drop precipitously to a level well below production costs.

"We can't continue to produce what we can't sell profitably," said a spokesman for Kerr-McGee, formerly the biggest U.S. producer, which in January announced it was writing off most of its uranium operations — a step already taken by other producers.

By and large, the U.S. uranium miners fell victim to overly optimistic forecasts for uranium demand for nuclear power plants.

"Unfortunately it has not grown at the rate that had been predicted," said Jack Edlow, president of Edlow International Co., a uranium services company based in Washington.

CSO: 5120/17

BULGARIA

CONSTRUCTION WORK AT KOZLODUY NUCLEAR POWER UNIT DESCRIBED

Recent Plenum in Vratsa

Sofia RABOTNICHESKO DELO in Bulgarian 23 Mar 85 p 2

[Article by Veselka Marinova and Iliya Borisov: "Increased Responsibility for the Great Construction"]

[Text] An expanded plenum of the okrug committee of the Bulgarian Communist Party was devoted today in Vratsa to decisive improvement in the party and political work for speeding up the construction of the 5th power block at the Kozloduy nuclear power plant. Member of the Politburo of the Central Committee of the Bulgarian Communist Party and first vice chairman of the Council of Ministers Chudomir Aleksandrov, ministers, vice ministers, leaders of trusts and organizations taking part in the construction of the 5th block, participated in the work of the plenum. The report of the first secretary of the okrug committee of the Bulgarian Communist Party in Vratsa, Svetozar Petrushkov, was devoted to an analysis of the most important tasks of the party organs and economic organizations, of the workers' collectives, in overcoming the delay that has been permitted and in speeding up the construction.

In his remarks, Comrade Chudomir Aleksandrov noted that the construction of the 5th block has now entered a decisive phase, which requires timely concentration of resources, a radical change in the approach to resolving various problems, a change in the method and style of work in all organizations. He devoted special attention to the question of the 5th block's place in the nation's rapidly developing economy, to the program-oriented organization for managing construction, to the necessity of passing over to complete 3-shift work.

The plenum made a resolution on speeding up construction, improving the social and domestic services for the populace and those working in the nuclear power city, improving the role of party organizations and activating communists to guarantee the start-up deadlines.

Nuclear Power Produced

Sofia RABOTNICHESKI DELO in Bulgarian 25 Mar 85 p 2

[Article by Iliya Borisov: "The Pulse of the First Nuclear Power Plant"]

[Text] From the start-up, at the end of 1974, of the first reactor to the beginning of March, the Kozloduy power supply engineers have produced 80 billion kilowatt hours of electric power from nuclear sources. Whereas during the first year barely 1 billion kilowatt hours were "transported" along high voltage lines from the shore of the Danube to the rest of the country, that quantity, with the help of the 4 reactors now working, reached the impressive figure of 12 billion, 735 million kilowatt hours during last year. The first nuclear power plant furnishes 30 percent of total energy production here. The efficiency of this most solid energy source is high: during 1984 the useability of the capacities reached the highest percentage ever recorded for using this type of reactor.

Activities Before the Deadline

Sofia STROITEL in Bulgarian 27 Mar 85 p 2

[Article: "The Offensive Before the Start-Up"]

[Text] One question is now facing builders, fitters, and specialists who are constructing the 5th power block at the Kozloduy Nuclear Power Plant, that is, ensuring the actual physical start-up of the first 1,000 megawatt reactor. With the invaluable assistance of the Soviet specialists at the site, good preconditions have been created for maintaining the strict scientific organization of labor, and the great possibilities of construction technology are being used to their fullest and in a technological way. At each subsite on the critical path to the start-up, two and three shifts are working.

Together with the builders, who are developing their activity on a broad front, the fitters are now powerfully entering the fray. Higher mounds of parts, machines, and heavy technological equipment are being handed over at the worksite.

This is one side of the coin. The other, to which the leadership of economic, party and trade union organizations are devoting necessary attention, is the transformation and maintenance of work site for the 5th power block into one of high standards.

Quite a bit has now been accomplished in this regard. Experience has been gained. A special program has been developed. It has been affirmed by the Ministry of Construction and Rural Organization. The necessary organizational-production and technological preconditions for timely fulfillment of construction and installation work are gradually influencing the conduct of the program already, in order to turn the construction workplace into an exemplary site.

In order to perfect the existing organization, the leadership has looked over the workplace. They have approached everything with a creative and critical eye. One of the basic tasks is to improve the interrelationships between the various construction, installation, and specialized organizations. Measures have been taken not to hinder them, so that they can assist each other and cooperate in the work process.

There is a technical council of highly trained specialists at the site. It has already decided all complex technological questions about perfecting the organization of work, as well as good advance preparation. Soviet specialists are included in the council. A number of engineering decisions have already been successfully carried out with their help. One of them is turning the construction workplace into one for fitting work, as well as increasing the factory preparation of the items produced, so that all that needs to be done at the site is to mount them. Operative resolution of problems in technology and organization of management of construction is actively working because it has been built into engineering-implementation organizations.

A system for material and moral stimulus of the collectives and the specialists, when they are carrying out work at subsites, levels, and junctions on time or ahead of schedule, has been developed as an integral part of the program for turning the workplace into one that sets standards. Much effort is being devoted to the affirmation of the brigade organization of labor and the piece work method of remuneration.

The winter made the work of maintaining the workplace more difficult. At many locations, the roads are full of potholes and destroyed by the heavy loads. At the work site there are a lot of panels, metals, and wast construction materials which have been discarded. There are dangerous, unused ditches and piles of dirt. The vans which the workers use are often out of order. There is no regularity in maintaining them.

With the active intervention of the party organization and the trade union committee, decisive measures have been taken to stop this negligence and deal with the retreats from the positions that have already been won. Work days have been organized for cleaning and putting in order the whole work site and the parks. The mechanics and autotransport system for solving big problems are now in harness. Necessary attention is being paid not only to cleaning and arranging, but also to the workrooms, the movement of mechanized vehicles, and the arrangement of materials. The green areas have been spaded. New decorative and fruit trees have been planted. They are planting flowers in the areas beside the vans.

"We are creating an organization to save not only the deadline for starting up the 5th power block, but also to turn the workplace into an exemplary construction site," the chairman of the office of the Council of Ministers and head of construction at the Kozloduy Nuclear Power Plant, Oved Tadzher, said. "This task is being carried out by everyone, with great desire and persistence."

Soviet Involvement at Kozloduy

Sofia VECHERNI NOVINI in Bulgarian 23 Feb 85 p 3

[Article by Nikolay Pavlenko: "A 'Cushion' for the Nuclear Power Plant"]

[Text] A group of scientists and engineers from Dnepropetrovsk will be sent to Bulgaria to conduct tests on the foundations for the turbine unit, which will have 1,000 MW of capacity, at the Kozloduy nuclear power plant. A correspondent from the Novosti Press Agency met with them, and he reported the following:

A few years ago, the only scientific research laboratory in the Ukraine which does research on the foundations for nuclear power plants was created at the Dneprovsk Engineering and Construction Institute. The "cushions" for many Soviet nuclear power plants were tested by specialists from this laboratory.

Its scientific director, Prof. Viktor Shvets, showed me photographs of the Southern Ukrainian, Kalinin, and Zaporozhe nuclear plants.

"At first glance," he explained, "this seems like compact, light equipment, but the above-ground mass of each of them totals hundreds of thousands of tons. It is natural that such constructions require a special foundation, since the turbine units at nuclear power plants with great capacities, together with their foundations, represent a very complex system. When the power block is working, the system's elements are vibrating; their behavior cannot be analyzed with theoretical computations alone. This relates to a great degree to power blocks with a capacity of 1,000 MW, where the so-called quitely turning turbines are mounted; they have a mass of moving parts whose highly dynamic loads are transmitted to the foundation."

The foundation, the "cushion," on which the nuclear power plant is constructed, must not be too brittle, because that will soon cause the mechanisms of the turbine unit to work irregularly, neither can the cushion be too soft, since resonances will appear, and the equipment can be destroyed. Hollows, cracking, and other defects are not permitted.

To what degree do the foundations satisfy these requirements?

The people who work at the laboratory, which is equipped with modern methods, automatic devices and apparatuses, many of which were developed at the institute, gave an answer to that question. They feel every meter of the mighty, large "cushion." Their highly sensitive apparatuses are prepared to fix on the smallest fissures in the thickness of the foundation, which might make normal operation of the plant impossible. They study the flat surfaces especially attentively, for they will receive the heaviest loads.

"Pay attention to the vibration stimulators in our construction," Prof. Shvets says at the testing area. "They are completely accurately modeled according to the force indicated to be applied to the characteristic parts of the

foundation. With their help we conduct natural tests of the foundations. Now in this area we are checking separate elements of the methodology for dynamic research on the "turbine unit/foundation" system, after which we will process the results on a computer."

"This type of research was recently conducted at the Zaporozhe nuclear power plant. We gave them an appraisal: 'The foundations are secure. The "turbine unit/foundation" system will work satisfactorily!' These conclusions were affirmed by the first test of the turbine generator. It was successfully concluded."

According to the words of Prof. Shvets, the nuclear power plant in Kozloduy is analagous to the construction of the Zaporozhe nuclear power plant; therefore the specialists at the laboratory are counting on rapid and high quality conduct of the tests on the foundations of the first Bulgarian 1,000 MW reactor."

"We understand," Prof. Shvets says, "that the power supply engineers in the Bulgarian People's Republic are waiting impatiently for the results of the tests. For without them they cannot begin work on installing the turbine units. We are prepared to set to work. And after that we expect new, even broader research, which will include determining the dynamic characteristics of the soil in the rayon where construction has been noted for another Bulgarian nuclear power plant, called Belene."

12334
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MOUNTING OF 1000 MW REACTOR BEGINS AT KOZLODUY

Leading Workers at Kozloduy Praised

Sofia STROITEL in Bulgarian 16 Apr 85 pp 1, 6

[Article: "People of Action at the Kozloduy Nuclear Power Unit"]

[Text] 11 April 1985. This workday has been turned into a great, exciting holiday for the fitters from the Yuriy Gagarin brigade, led by Gospodin Yordanov, twice hero of socialist labor. The noteworthy 25th anniversary of the founding of the brigade was celebrated in the most festive way possible. Together with this, raising and installation of the body of the first 1,000 megawatt reactor outside the Soviet Union was completed.

Early in the morning around the reactor section, where the huge body of the reactor seems silvery, many Bulgarian, Soviet, Vietnamese, Cuban, and Polish builders and specialists have come. After a special "bed" was prepared for the reactor's body, the boys of Gospodin Yordanov's brigade arrived, together with the Demag operators, and they set to work. A commission of Bulgarian and Soviet specialists once again made a precise overview of the preparation, and when they were certain that everything was in order, they signed the protocol.

The operators of the Demag, the most powerful crane in our land, Lyuben Borisov and Ivan Petkov, accepted Gospodin Yordanov's order and gripped the handles of the huge mechanism. Dozens of steel cables quivered, and the 320 ton body of the unique energy aggregate was lifted off the special pedestal. Slowly and calmly, despite the strong wind, the body was lifted higher. Hundreds of eyes directed their gazes to the silvery "bird," which was moving towards its "bed." This entire difficult and responsible process was directed by Bulgarian and Soviet specialists. And in only a few hours, the reactor was placed on top of the steel ring without any deviation.

When the vice manager of the Yuriy Gagarin brigade, Todor Nonin, a person with great mastery and experience, announced on the radiotelephone that the operation of lifting and installing was successfully concluded, everyone's face lit up with a radiant smile. Bulgarian and Soviet specialists and workers shook calloused hands until they hurt. There were kind and cordial embraces, an expression of satisfaction that a major step had been taken toward realizing the start-up of the 1,000 megawatt power block.

"Although we were certain that we would successfully conclude this operation," Gospodin Yordanov noted, "we were very excited. My comrades from the brigade have accumulated valuable experience and apply it knowledgeably in practice. We were truly glad that this new, extremely great victory of labor had been carried out on the day our collective was celebrating the 25th anniversary of its founding and on the eve of Cosmonauts' Day, 12 April, when our patron was the first person in space."

There was a lot of warmth and sincere love in the words of Soviet specialist Pyotr Danilenko:

"It is remarkable that our Bulgarian friends have accomplished a tremendous, I would say unique, feat. They have boldly stepped into the field of nuclear power and are worthy of standing alongside the most advanced nations in the world. I cordially congratulate the Bulgarian Gagarins on the praiseworthy victory of labor and the noteworthy anniversary, 25 years of living and working as one huge, friendly family."

Physically tired but psychologically uplifted, Gospodin Yordanov and his comrades gathered in the evening to celebrate their 25th anniversary. At the festivities arranged by the Central Council of the Bulgarian Professional Unions, the Central Committee of our trade union, and the managers of the Energomontazh installation rayon in Kozloduy, many guests and friends of the brigade: Party, economic, and trade union activists, specialists from Sofia and Vratsa, from the Kozloduy nuclear power unit, took part in the celebration. Among them were Georgi Karaulanov, secretary of the Central Council of the Bulgarian Trade Unions, engineer Oved Tadzher, representative of the office of the Council of Ministers and head of the nuclear power unit, Pencho Sirakov, secretary of the Central Committee of the Dimitrov Communist Youth League, engineer Stoyan Tsvetkov, secretary of the Central Committee of the trade union of workers in construction and the construction industry, Ventsislav Angelovski, secretary of the krug committee of the Bulgarian Communist Party in Vratsa, Lazar Kharizanov, chairmand of the okrug council of the Bulgarian Trade Unions, and Kil'o Tusev, first secretary of the communal committee of the Bulgarian Communist Party in Kozloduy.

The local men celebrating were warmly greeted by dear guests from the USSR, Poland, Vietnam, Cuba, and Nicaragua, who are working shoulder to shouder with them in building the 5th power block.

A photo exhibition at the Pen'o Penev union house of culture laid out, in a most interesting way, the story of the valuable, vital path of work of the fitters in the Yuriy Gagarin brigade.

The brigade was founded during the construction of the Vilhelm Pik cement plant near the village of Beli Izvor. From that time until now the industrious men have put their knowledge and mastery into the construction of a number of enterprises that are important for the country's economy. Beautiful, long-lasting traces were left in the construction of the Chemical Combine near Vratsa, the Chemical Plants in Vidin, the Combine for Cellulose and Paper near the city of Miziya, the Combine for Heavy Machine Building in

the city of Radomir, and many other places. But the brigade truly towers over others and deserves the greatest recognition for construction of the nuclear suns at Kozloduy. For 15 years now these strong men have cooperated with their labor in "capturing" the atom and making it serve the peaceful aims of man.

Depending on the size of the tasks, the brigade increases or decreases its staff. New people come into it, but in the collective they maintain the principles of industriousness and honesty, giving it their all and iron discipline, friendship and comradeship in fulfilling each task, no matter how difficult.

The celebrating brigade received many greetings and awards. The words from the Central Council of the Bulgarian Professional Unions, spoken by its secretary Georgi Karaulanov, resounded with exceptional warmth. After that he read a decree from the State Council, that the brigade had been awarded the Red Banner of Labor medal. To the riotous applause of those present, Comrade Karaulanov affixed it next to the Banner of Labor Glory.

There were words of recognition as well for the great and long-lasting achievements in the greeting from the okrug committee of the Bulgarian Communist Party in Vratsa, read by the secretary of the committee, Ventsislav Angelovski.

On behalf of the leadership of the Ministry of Construction and Village Systems and the Central Committee of the union, its secretary engineer Stoyan Tsvetkov gave an address and gave the members of the brigade two golden pins: "Master Kol'o Ficheto" and "Outstanding Worker for the Ministry of Construction and Rural Development."

Greetings and gifts were also brought on behalf of the Central Committee of the Dimitrov Communist Youth League, Soviet specialists, Vietnamese workers, the Montazhi State Economic Trust, and many other economic and social organs and organizations.

Gratitude to USSR

Sofia STROITEL in Bulgarian 16 Apr 85 p 6

[Text] Bulgarian and Soviet communists and Komsomol members, workers and specialists are working shoulder to shoulder in the construction of the 5th power block. Over the course of several years they have gained valuable knowledge in mobilizing workers' collectives and utilizing material resources, in the courageous application of avant-garde technologies and scientific-technical progress. Day after day they are approaching their main goal, the start-up of the giant of our energy policy, the fifth power block, with its 1,000 megawatt capacity, on the eve of the Thirteenth Congress of the Bulgarian Communist Party.

In a conversation with Milko Torbov, secretary of the joint construction committee of the Bulgarian Communist Party, the multifacted trends in the joint work were explained. He reported:

"In the first place," he pointed out, "we see the need for fuller mastery of the experience of our Soviet comrades' experience in party-political and organizational work, in trade union and Komsomol organizations. This is indeed a school for us, a boundless reservoir of knowledge. With the development and realization of joint measures for unity in our work, we will achieve good results in raising the level of class, patriotic, and international education of the builders. It will help even more to solidify relations between us. In practice this is affirmed by joint celebrations of notable days, such as 1 May, 9 September, and 7 November, in order to become acquainted with life in the Soviet Union and our homeland, in the Communist Party of the Soviet Union and the Bulgarian Communist Party. These unforgettable holidays are turned into joint festivals, meetings and concerts, which are organized for various purposes. Soviet specialists often give lectures for our workers' collectives."

"With the aid of joint photo displays, the achievements of the Soviet Union and our country in the construction of a developed socialist society are demonstrated, as well as the significant results attained in joint work at the site. Through a special program, we are now organizing talks, exhibitions, and meetings with veterans, which are devoted to the 40th anniversary of the victory over Hitlerian Fascism and Japanese militarism."

"Together with the builders and fitters from Poland, Cuba, Vietnam and Nicaragua, who are working at the site, everyone is learning from the exemplary discipline, lofty feeling of social responsibility and political maturity of the Soviet specialists."

"In second place we see joint, active work in affirming socialist competition, under the title "Friendship." It began at our workplace in the Yuriy Gagarin collective of fitters led by Gospodin Yordanov, twice hero of socialist labor. The competition already has great national and international resonance. During this last year alone 58 agreements were made between our construction and installation brigades and Soviet specialists for early resolution of various themes and assignments. Seven Soviet specialists, led by Ivan Gladkov, concluded an agreement with the technological flow line of Ivan Radev, hero of socialist labor. As a result, it was possible rapidly to adopt reinforced concrete walls for the cylindrical part of the reactor section. Much time was saved. Another group composed of Bulgarian and Soviet brigades completed the steel reinforcing at the 25.70 level 3 days early. The joint work of the Yuriy Gagarin brigade with Soviet specialists brought about the laying of the support frame for the reactor 7 days early."

"The application of leading Soviet experience helps a great deal in affirming the work of the group which handles the engineering preparation at the site. It has its specific tasks: explaining beforehand the duties of those participating in the construction and installation process. This is based on the utilization of scientific-engineering, technical resolutions and improved organizational measures. In this regard, we should note the service of Soviet specialists Pasyuta, Rudolf, Ivanov, Chertkov, Denik, and others. By conveying their experience to their Bulgarian colleagues, they ensure fulfillment of the measures, which have an economic effect of close to half a million leva."

"In third place we see the participation of the goal-oriented "Friendship" socialist competition. It is involved in carrying out particularly complex and at the same time urgent types of work at sub-sites, which lie on the critical path toward building the 5th power block. While laying concrete at the 22.30 level of the lower block of the shaft of the reactor section, for example, special care was needed. The agreement that had been concluded ensured timely completion of that task, as the construction and installation work up to the 36.90 level is developed along a broad front. This was decisive in the start-up of this crucial production junction."

"And most of all our joint work helps us constantly, systematically, and in a high quality manner to obtain such knowledge and experience from our Soviet comrades. Technical conferences have turned out to be a very effective form. All problems are explained at these conferences every day. Thematic assignments for resolution, in a given period and under difficult conditions, of the construction of the Nuclear Power Unit are determined."

"Soviet people, with their great know-how, competence and training, participate with us in the development of a comprehensive program which will ensure the start-up of the 5th power block. Engineer Sapir L'vovich, the leader of this group, has displayed special activity."

"By the end of this year the number of Soviet specialists will increase several times. This requires from us utilizing the leading Soviet experience as rationally and effectively as possible. In this way our entire collective will fulfill the resolutions of the February Plenum of the Bulgarian Communist Party."

"1985 is a decisive year in the timely start-up of the 5th power block. This is a major political task. Together with the Soviet specialists, we understand this well."

"We would like to use the opportunity offered by STROITEL to express, on behalf of the collective of the Nuclear Power Unit, with its thousands of members, our boundless gratitude and admiration for our Soviet comrades, For the fact that they spare no efforts and knowledge in helping us in a fraternal and familiar way."

Friends from Socialist Countries

Sofia STROITEL in Bulgarian 16 Apr 85 p 6

[Text] They came to us timid and inexperienced. We did not know what language we would use to communicate. Their strong desire to work and our aspiration to help them grow into good builders and fitters merged into one aim. Most of the Vietnamese have already proven to be highly trained masters in their professions; they have turned into skillful welders and are already performing complex operations with a high level of quality. This is what was shared with us by Petraki Stoimenov, hero of socialist labor, leader of the comprehensive construction brigade, when the labor of the Vietnamese comrades was mentioned.

They came here from thousands of miles to be trained and after that to go back to their native country, where they will participate actively in building their own nuclear power plant. The Vietnamese builders have turned out to be diligent and hard-working people. Together with the desire to comprehend special features of this unique construction site, they are also learning the Bulgarian language.

The most frequently used word at the construction site is "friendship." It is pronounced proudly and has a beautiful touch of the Bulgarian, Vietnamese, Russian, Polish, Cuban, and Nicaraguan cultures. It accompanies the chronicles of the fifth power block. It is there during the workdays, when the miracles of heroism are born.

Here, at this site, more than a decade ago, the so-called "Friendship" international competition was born. Its initiators were a group of Soviet and Bulgarian workers and specialists under the leadership of twice hero of socialist labor Gospodin Yordanov. Here is what Vasil Markov shared with us; Markov is chairman of the Joint Construction Trade Union Committee and plenipotentiary of the Central Committee of the Bulgarian Trade Unions for the Kozloduy nuclear power plant:

"At first the competition called Friendship began with only separate brigades; now the entire collective of thousands and thousands of builders and fitters are taking part in it. The language barriers are also being overcome successfully. The Soviet comrades are wonderful as specialists and as people as well. We are truly happy to be working with them. They teach us not only know-how, but also everything that is beautiful to learn about life. The Vietnamese are skillful welders, the Cubans marvellous builders, the Poles are great specialists in metal constructions. Even if one has no specialty or training, here at the nuclear power plant one can learn to master several. This is the scale of construction here.

A Vietnamese welder named Chont Doc Thang, who has mastered the intricacies of his profession, told us: "I won second place in the competition with the best masters around the country, leaving hundreds of others behind me. I owe this to my Bulgarian friend and comrade, Yordan Mikhaylov, that is, Dancho."

Soviet engineer Zina Bunsheva stands out because of her love for her job and her openness in helping others and exercising the necessary authoritative supervision. With her radiant smile and charm, she manages to take charge and lead the people, and that is why she is a welcome and desired guest at all levels of the construction site.

The Cubans readily and willingly give their labor, knowledge, and skills in the construction of this site. Everyone works so that the brigade might win the right to bear the name of Bulgaria's great son, Georgi Dimitrov. The day when this name will be won is not far away.

Drawings must be studied carefully, so that work can proceed without flaws at the site. The Vietnamese comrades Choc Duc and Le Bing are well aware of

this. In this regard, their successes are due to the close and direct help of Soviet engineer Lera Bochkar'ova.

Together with the oxygen burners, the flame of the Friendship international competition also burns. It unites the fitters and builders from the fraternal countries and leads them on to one goal: building the fifth power block on time and with high quality.

I am profoundly convinced that one day soon, when the power will start to flow from here, everyone will proudly say: "We also took part in the construction of that unique site, the flagship of Bulgarian power supply." This shout will be raised by Bulgarian builders and fitters. Traces of the fruitful work will remain with the Soviet people too, people who gave their heart and soul in working here, on the shore of the great river. The builders from Cuba will not forget the exciting days of joint work. Hundreds of Vietnamese comrades will take back many memories of sunny Bulgaria. The Polish metal constructors will leave lasting and beautiful traces. Each one has kept in his heart the moments and thrills of unforgettable hours. Little flames of competition in various brigades will turn into the roaring fire of the 1,000 megawatt power heart.

I walk along the levels of the 5th power block. Everyone is hurrying, hurrying. Everywhere I hear friends talking, the language of friendship, which warms and leads us ahead and upward.

BTA Report on Reactor

Sofia BTA in English 1706 GMT 4 Apr 85 AU

[Excerpt] --Sofia, April 11 (BTA)--Bulgaria nuclear power generation is gaining "atomic speed". Today assembly work was launched on the first 1,000 MW reactor outside the Soviet Union. It is being mounted within the fifth generating unit of the Kozloduy nuclear power plant. The reactor has been manufactured at the United Works in Izhora near Leningrad. This reactor belongs to a new generation of the "vver" [as received] type. The thousand megawatt reactor boasts thrice as great thermal power, enhanced reliability and a stable control and safety system. The experience amassed so far has enabled Bulgaria to move on to a fundamentally new stage in the promotion of nuclear power generation. The new reactor is the first of the two 1,000 MW Systems in the extension of the Kozloduy nuclear power plant (on the Danube). The Bulgarian Government has recently decided to build a second nuclear power station, "BELENE" again on the Danube Bank. It will have four generating units, each 1,000 MW strong. It will be constructed according to the block system which is believed to be a most advanced one.

12334
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DEVELOPMENT OF NUCLEAR POWER CAPACITY ASSESSED

Sofia SPISANE NA BULGARSKATA AKADEMIYA NA NAUKITE No 1, 1985 pp 10-15

[Article by Prof. Zhel'yu Zhelev, Prof. Vasil Khristov, senior scientific associate Tikhomir Apostolov: "Ten Years of Nuclear Power in the Bulgarian People's Republic"]

[Text] The rates of development of the economy and productivity of labor in comtemporary society depend to a great degree on the development of power supply, on the rapid introduction of new power capacities. Now an important precondition for rapid technical progress is an increasing rate in the development of power supply over other branches of the national economy. This rapid growth in power supply also applies to our country, which is characterized by high rates of industrial and economic development.

The green light for the development of nuclear power in our nation was given by the Central Committee of the Bulgarian Communist Party at its November Plenum (1969), at which a program for the development of a national energy complex during the Seventh 5-year-Plan and up to 1990 was adopted.

The fundamental share of satisfying energy demands at the present stage and in the near future in the whole world has fallen to nuclear power. It is widely recognized by specialists that nuclear energy is the only alternative in the development of a strong power supply.

From the beginning of the development of nuclear power, which took place on 27 June 1954, when the first nuclear power plant in the world was started up at Obninsk near Moscow, to now, 294 reactors with an electric capacity of more than 173 million kilowatt hours have been built. They cover around 10 percent of the world electrical production. The forecasts for nuclear power capacities envision reaching 430 million kilowatt hours by 1990 (18 percent) and around 7000 million kilowatt hours (23 percent) by the year 2000.

During 1966, an inter-governmental agreement was signed with the USSR to construct the first nuclear power plant in the Bulgarian People's Republic. The design for the Kozloduy Nuclear Power Plant [AEK] was developed by the Soviet design organization, Teploenergoproekt together with our Energoproekt Scientific Research Planning and Design Institute for Power Systems design organization at the former Ministry of Power Supply. The design, construction, and operation of this great piece of nuclear equipment has turned into

a whole contemporary school for studying Soviet experience for our Bulgarian designers, builders, and fitters in the area of nuclear construction and technology.

Construction of the Kozloduy AEK began on 6 April 1970. The physical start-up of the first reactor took place on 30 July 1974, and the power supply start began on 14 July 1974. The design capacity was reached on 28 October of the same year, and the second reactor was started on 5 November 1975. On 25 June 1982, the fourth and final reactor in the construction of the first part of the Kozloduy AEK was started in operation, with VVER-400 type reactors.

In 1980 ground was broken for the new site of the second plant, with 2 new perfected Soviet reactors, each with a capacity of 1,000 megawatts (VVER-1000). It is foreseen that by 1990 a third nuclear power plant will be built, based on two VVER-1000 reactors, and with this the nuclear power capacity in our country will reach 5760 megawatts. These are the outlines of a broad program for the development of nuclear power in our country. In the short space of 15-20 years we will have 5760 megawatts of nuclear power capacity, which will equal all the installed capacity we had in this country in 1975. After 1990, the program, foresees construction of a nuclear power plant based on fast-neutron reactors.

The VVER-440 type reactors work with slightly enriched uranium fuel (2.5 percent average content for uranium-235). The nuclear fuel comes in the form of cylindrical tablets with a diameter of 7.55 millimeters and a height of 30 millimeters of uranium dioxide. A group of 82 such tablets, enclosed in zirconium alloy pipes, form uranium rods with a diameter of 9.1 millimeters and a height of 2.5 millimeters; these are the so-called heat-separating elements. A group of 126 heat-separating elements, with a distance of 12.2 millimeters between them, are placed in the form of a screen and are aligned in a hexagonal cassette, which has an equivalent diameter of around 15 centimeters. The active zone has a diameter of around 2.9 meters and a height of 2.5 meters and consists of 349 hexagonal fuel cassettes. The weight of the uranium fuel is 42 tons, one-third of which is replaced in the course of operation each year with new fuel. The cassettes are raised from the central part of the active zone, the outer cassettes are moved inside, and new ones are placed in the peripheral cassette sockets of the active zone. In this way a more even "burning" of fuel is achieved in the entire active zone. It is located in a steel body with an external diameter of 3.83 meters and a height of 11.5 meters, with walls that are up to 120 millimeters thick. Water under pressure of 120 atmospheres circulates in the body; it passes through the active zone and acts as a retardant on the neutrons and a coolant for the heat-separating elements. The temperature of the water going into the body is 270 degrees Celsius, and coming out it is 300 degrees.

The VVER nuclear power reactors, which work with heated neutrons, have already been affirmed in practice as economically efficient, reliable, and safe in operation. Nuclear power policy is based on these reactors, at least up to 1990, and perhaps even to the end of the century. Because of this, design-consultant and research work is continuing to improve their basic electrical

capacity to 1,000 megawatts and even more. These are major pieces of power equipment, which are now at the beginning stages of their industrial development. Constant development and perfection are necessary for a number of their junctions and systems. Efficient utilization of these powerful reactor systems and ensuring optimal work regimens require new, more precise data about the physical processes taking places in their active zones, and perfection of the methods for fuller description of these processes. Experimental information about the interaction of the neutrons with the nucleus of the fuel and the construction materials, as well as the power displacement of the neutrons at various points in the active zone in a number of cases has not satisfied the precision needed for reactor calculations. Special attention is being paid to experiments conducted on critical systems, an analog of the new active zones of the reactors, where the values of the integral neutron data measured are utilized as a reliable criterion for checking the precision of the resulting microscopic data (efficiency of the microscopic sections of dispersion, absorption, division, etc.), set in the reactor programs for calculations. In order to attain this goal, the Central Physics Institute of the Hungarian Academy of Sciences in Budapest, with the fraternal assistance of the USSR, built the ZR-6 critical reactor system in 1972; it is an analog to the active zones of the VVER-1000 types reactors. The Provisional International Collective (PIC), created for the ZR-6 critical reactor system, united the efforts of specialists from nuclear institutes in the member-nations of the CMEA, in the field of physics research on the VVER type reactors.

The basis of the reactor calculations is formed by the neutron-physical characteristics of a single elementary cell in the active zone (the heat-separating element and the retardant surrounding it). The succeeding stage is represented by the whole calculation for the reactor to find the disposition of the power division, the coefficients of irregularity, the determination of optimal cartograms for re-configuring, etc.

Measurements have been made on the ZR-6 critical system with great precision for the neutron-physical parameters at various configurations of the active zone, under which changes are made in the distance between the heat-separating elements (1.0 and 12.7 millimeters), the degree of enrichment of the nuclear fuel with uranium-235 (1.6, 3.6 and 4.4 percent), the level of the water retardant in the basin of the reactor, the concentration of boric acid in the heat carrier (0, 4, 7.2 grams per liter), etc.

In parallel with raising the precision of the measuring methods, new perfected programs have been developed: they are based on greater proximity to the Boltzman control for neutron transfer. A comparison between the measured and calculated sizes of the micro- and macroparameters of the active zones permits the precision of the microscopic and averaged group data, which define these parameters, to be evaluated and improved.

Joint work and cooperation between the member-nations of the CMEA in the field of reactor physics research, following the line of the PIC, is one of the hundreds of bright examples of socialist integration in action, based on the valuable experience of Soviet nuclear science and technology. It is one

of the important factors in raising the level of effectiveness of our scientific-research and application activity in the area of nuclear science and nuclear power supply.

Taking into account the assistance of Soviet nuclear science and technology in the construction of our nuclear power supply here, we must note the great role of our first research reactor, the IRT-2000, built and set in operation with the fraternal assistance of the USSR in 1961. Highly trained engineers, physics and chemistry cadres, the pioneers of nuclear power supply in our country, trained on and learned from it. A portion of this group became the leading nucleus of our first nuclear power plant at Kozloduy. Based on this reactor and on our productive cooperation with the Joint Institute for Nuclear Research in Dubna, with the I.V. Kurchatov Institute for Nuclear Energy, with the Physics and Power Supply Institute in Obninsk, and with the participation of the PIC for reactor-physics research in Budapest, a number of scientific units from the Institute for Nuclear Research and Nuclear Power Supply (INRNPS) at the Bulgarian Academy of Sciences conducted successful research work on current scientific and practical problems of neutron physics, on reactor physics and technology, on radio-chemical and radiational dosage metering, on radiometry and nuclear measuring methods, directly or obliquely connected with the problems of building nuclear power supply in our country. Valuable personal research experience was gained on the methods for internal reactor measurements and internal reactor control, on non-destructive methods for analysis of the nuclear fuel, on numerical methods for calculating reactor systems, on studying neutron transfer in reactor retardants and protective media, on experimental reception and evaluation of neutron data for design and operation of new reactor systems with rapid neutrons. Radio-chemical methods for obtaining, processing, and maintaining radioactive isotopes, as well as radioactive wastes, have been developed. Results have been achieved in the field of dosage metering control, etc.

In 1975, a protocol was signed by the Bulgarian Academy of Sciences and the Ministry of Power Supply for long-term cooperation related to mutual assistance in joint work by the INRNPS and the Kozloduy nuclear power plant. The Bulgarian Academy of Sciences took part in the preparation of the scientific-research provision of engineering designs for the Kozloduy nuclear power plant during the Seventh 5-Year-Plan. The main goals of this scientific service were:

a) ensuring optimal work regimens for work on the nuclear power plant and the most efficient use of nuclear fuel;

b) discovering and using in a practical way reserve capacities in the system through raising its nominal capacity;

c) radiational safety and technical reliability in the operation of the nuclear power plant.

During the years of the Seventh 5-year-Plan, a number of measurement methods and apparatuses were developed by the INRNPS and the Kozloduy nuclear power plant, as well as counting methods and programs, which optimize the work

regimens of the plant's nuclear reactors and its nuclear safety. These are: efficient methods for measuring the depth of burning of the nuclear fuel; the BIPR-5K program for realigning the nuclear fuel in the active zones of the VVER-440 type reactors and determining the neutron-physics characteristics; mathematical models and programs for analysis of stationary and non-stationary thermohydraulic processes and kinetics in the VVER-440 reactors; methods and programs for evaluating the reliability of the work of the nuclear reactors in the nuclear power plant; methods and technologies for deactivation of low-level radioactive waters from the Kozloduy nuclear power plant. The economic effect already recognized from these developments during the Seventh 5-Year-Plan have reached 10 million leva. In the 3 years of the Eighth 5-Year-Plan, new perfected measurement apparatuses, methods, and programs have been developed and implemented; these lead to:

--a passive x-ray fluorescent method and gamma-spectroscopic methods for absolute determination of the plutonium-uranium relationship in the spent fuel; a gamma-spectroscopic method for control of the enrichment of the nuclear fuel; absolute gamma-spectroscopic determination of the depth of the burning of the nuclear fuel. Through these methods, the degree of uranium burning and accumulation of plutonium are determined, with about three times the accuracy over the current methods. This ensures the possibility of correcting the theoretical-counting methods against the program results, which lead to a selection of the optimal cartograms for configuring the nuclear fuel in the active zones, to lengthening the time that the nuclear fuel can be utilized and to the realization of significant savings;

--with the physical start-up of the fourth power block at the Kozloduy AEK, with the configuration of nuclear fuel in the active zone, a tri-detector apparatus for measuring the neutron flow in accordance with the rules for nuclear safety was implemented;

--the BIPR-5K program created for configuring the nuclear fuel in the active zones of the VVER-440 type reactors and determination of their neutron-physics characteristics was implemented. The program represents a new program realization of the BIPR-5 algorithm and a further development of the BIPR-5K program. What is essentially new in the BIPR-5K program is the utilization of a new iterational method for resolution of evening out diffusion, proposed by Prof. Lebedev, and the new possibilities created for calculating: a generalized scheme for calculating the campaign, [illegible]ing the maximal coefficient of unevenness of power released in the [illegible]settes during reconfiguration of the fuel according to the ORAKS algorithm, automated comparison of the theoretical and experimental determination of the power released by cassette. The new types of calcualting expand the circle of tasks solved by the BIPR-5K program, substantially decrease the technical work on completing the calculations and create favorable conditions for the creative contributions of specialists occupied with the operation of the VVER-440 reactors.

The DERAB-II-E program for the analysis of microdetermination of the neutron flow in the fuel cassettes of the VVER-440 reactors has been implemented with the start-up of the fourth block at the Kozloduy nuclear power plant.

The economic effect achieved from the Academy's practical developments implemented in the field of nuclear power supply during the first 3 years of the Eighth 5-Year-Plan (1981-85) has reached 25 million leva. This effect is a true indicator most of all of the high scientific-technical level of the developements mentioned above. These assignments are organically linked with and come about because of the problems taken up by the academic institutes. Our cooperation with the Soviet nuclear institutes and our participation in the work of the PIC permits us to develop the most up-to-date and accurate experimental and theoretical methods for calculating in the area of neutron and reactor physics, which represent the physical basis of modern nuclear power. Our colleagues have made a contribution to the study of the physical parameters of the new, powerful, VVER-1000 nuclear power reactors; to the study of resonance parameters of the separated nuclei and obtaining neutron data for reactors with rapid neutrons; to the development of new impulse methods for determination with high precision (0.5 percent) of the albedo of the heated neutrons in the reactor retardants; to the development of new reactor programs with increased accuracy and quick action, etc.

We must take note also of the active participation of the Bulgarian Academy of Sciences' specialists in the development of a comprehensive program for scientific-technical progress in our country in the field of nuclear power for the years of the Ninth 5-Year-Plan and on to the year 2000.

The positive practice of the Bulgarian Academy of Sciences in coordinating its scientific-research activity most closely with the main trends in scientific-technical progress in our country has been affirmed, based on the organizational and coordinational agreements made with the economic ministries (including the Ministry of Energy Resources).

The Bulgarian Academy of Sciences' institutes are included more broadly in the scientific provision of power services in our country, including nuclear power. For the period from 1986 to 1990, and on to 2000, a developed research plan has been formulated to include such basic directions as: the physics for perfecting reactor systems with heated neutrons; scientific research on creating reactor equipment with rapid neutrons; scientific research on rendering harmless and storing radioactive wastes and equipment; nuclear physics and metal physics research on radiational behavior in reactor materials, with a view toward their use in construction of reactors.

Despite our rather modest participation, we have been included in the line of the CMEA and the tremendous program in the USSR for creating future thermonuclear reactors with the goals of a large increase in power. One of the tasks in which we are participating is the development of methods for diagnostics of hot thermonuclear plasma and more specialized development of optical and x-ray spectrometric methods. We are studying the transfer of rapid 14 MeV neutrons in materials from the blanket of hybrid reactor systems, as well as studying the constants in the interaction of neutrons with these materials, with the assistance of our neutron generator.

This program of the Bulgarian Academy of Sciences for scientific research is closely linked with common problems of the development of nuclear power in the

countries of the socialist community, as well as with current problems we encounter in constructing our nuclear power supply here. In this way our scientific workers and specialists, with the help and closest cooperation of scientific workers and specialists from Soviet nuclear institutes will make their worthy contribution to the broad program outlined for the development and construction of nuclear power supply in the Bulgarian People's Republic.

12334
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GERMAN DEMOCRATIC REPUBLIC

POTENTIAL USE OF NUCLEAR ENERGY FOR HEATING PLANTS CITED

Leipzig ENERGIETECHNIK in German Vol 35 No 3 Mar 85 pp 87-89

[Article by Dr of economics Dieter Herrmann and Prof Dr of natural sciences Dieter Ziegenbein, with the GDR Academy of Sciences and with the Central Instittue for Nuclear Research, Rossendorf; Prof Dr of engineering Herbert Munser and lecturer, Dr of science & technology Beate Reetz, Technical University of Dresden, Section for Energy Transformation: "Considerations of the Long Term Development of the Heat Supply in the GDR".]

[Excerpts] 4. Nuclear heating Supply Plants

Nuclear energy can be used in two ways to produce low-temperature heat: On the one hand by coupling the heat output from nuclear power plants (KKW), which improves their primary energy utilization; on the other hand, by erecting special nuclear heating plants (KHW) (3).

Coupling the heat out from KKWs presents no basic technical difficulties since decades of experience with conventional power can be used for this. The problems of nuclear safety are to be considered a special feature. An initial installation for coupling out the heat was started up in the previous winter in the KKW "Bruno Leuschner".

For KKWs with WWER (water-water energy reactors)-1000, which will shortly be deployed in the GDR, turbines have been developed in the USSR and the CSSR which make it possible to couple out heat amounting to maximally 30 percent of the thermal power, that is a maximum of 900 MW per 1000 MW block (4). The flow temperature of the hot water in the heating circuit here lies between 150°C and 180°C. While retaining the principle of the condensation turbine, these systems, through the electrical energy system, can manage the full need for electrical power at peak times. The heat coupled out from the KKW is associated with a much lower expenditure for fuel than the heat produced by KHWs. As regards its fuel costs, it lies far below those of conventionally generated heat. However, its broad utilization has limits because of the locations of the KKWs. For reasons of nuclear safety, the KKWs require certain minimum distances from densely populated areas, which generally also represent areas with a high heat demand. Only towards the end of the nineties will the process of coupling the heat out of KKWs therefore achieve a significant scope. The heat will then have to be transported over greater distances than have previously been achieved. This presupposes certain steps to increase the

transport efficiency of the heat carrier - namely hot water for the foreseeable future - by efficient layout and operating technologies for the remote heating lines and by reducing the return temperature. If one considers the low fuel-heat expenditure for heat coupled out from KKWs, the question does indeed arise, to what extent the scope of heat utilization could be increased by settling heat-intensive industrial or agricultural processes in the neighborhood of KKWs (5). Certain forms of off-heat utilization are already practiced with conventional power plants. These should be taken over and should be expanded in correspondence with the higher parameters of the coupled-out heat. A Soviet author has made an analysis of the utilization of low-temperature heat. This analysis shows that numerous application areas for economical low-temperature heat can still be opened up (6).

On a world-wide scale, efforts have been made for about a decade to develop special KHWs for furnishing low-temperature heat. A series of measures were implemented here, which make it possible to achieve a still greater safety level with KHWs than with KKWs. Thus, their minimum distance from densely populated areas can be reduced as compared to the distance for KKWs.

The greatest progress has been made with the development of the Soviet KHWs type AST 500. It is being erected in a double-block arrangement in the cities of Gorki and Voronash. Each block has a thermal power of 500 MW. Start up of the first block is expected next year.

The following measures are put into effect with the AST 500 in order to reach a high safety level:

- Natural circulation in the first loop; this increases the reliability of heat exhaust.

- Integral arrangement of the first loop in a double-walled pressure vessel; this also reduces the probability of the reactor core drying out.

- Lowering the parameters in the first loop compared to those in the first loop of pressurized water reactor; thus the probability for the occurrence of accidents is strongly reduced.

- Setting up three loops with graduated pressure; thus a transfer of radio-activity from the reactor loop into the load loop is prevented.

The reactor exit temperature of the coolant is 200°C in the AST 500. The flow temperature in the heating loop is 150°C. Designs for KHWs, whose implementation has not yet been begun, however, are known from France (THER-MOS), Sweden (SECURE), and Canada (SLOWPOKE) (7, 8). These KHWs are designed for flow temperatures of 90°C to 120°C in the heating loop. Consequently, they can be used only for communal heat supply. Because of their high specific costs, these projects could not yet establish themselves commercially, although they contain some interesting technical solutions. An exception is the KHW type SLOWPOKE, whose erection with a power unit of 2 MW is supposed to begin this year. In addition, there are a series of further studies and developments

concerning KHWs, especially such with organic coolants (9). However, these have not yet achieved technical maturity, and their future large-scale utilization is still quite questionable.

5. The Integration of Nuclear Heat Sources within Remote Heat Networks

Nuclear energy conversion systems have high safety levels, whose implementation requires considerable expenditure. This expenditure depends only slightly on the block size. Consequently, nuclear systems possess a strong cost regression, i.e. the specific investments per unit power strongly decrease with increasing block size. This circumstance makes it necessary to erect KHWs in the largest possible block units. Estimates have shown that only with a block size of 500 MW do the specific investment costs of KHWs, relative to unit thermal power, become comparable with those of KKWs.

For smaller block sizes, they far exceed the cost of KKWs. Taking the circumstance into account, it lies close at hand for the GDR to concentrate on the utilization of type AST 500 as regards the deployment of KHWs, especially since KHWs of other block sizes will not exist in the CEMA region within the foreseeable future (10). Studies have been performed in the Soviet Union concerning a KHW with a block size of 300 MW (AST 300). They led to the result that the absolute investment costs would be only about 15 percent less than with the AST 500, i.e. the specific costs would be about 40 percent higher than those of the AST 500. The flow temperature in the heating loop would be only 120°C with the AST 300. Thus, the utilization of this KHW for industrial heat supply is virtually excluded.

Orientation towards the use of the AST 500 raises the question, to what extent KHWs of this type can be integrated in the GDR with a thermal power of 1000 MW with a double-block arrangement and 500 MW with a mono-block arrangement. It is evident that, at the present time, this is possible only in a few heat-demand centers. Studies of the heat demand and its probable development have shown, however, that numerous heat-demand regions exist in the GDR, where such heat sources can be integrated in the future. Such regions are territorially limited and arise from the integration of communal and industrial consumers. Distribution systems will have to be created by linking and expanding existing hot-water networks. In preparing the remote-heating system of the city of Gorki for the start-up of the first KHW with two blocks of type AST 500, it is also necessary to aggregate insular areas by connection lines, to create a system of magistral lines, and to erect coupling stations between transit lines and the magistral system. The parallelism between steps taken in the Soviet Union and in the GDR, to increase the centralization of the heat supply becomes clear in virtue of the fact that starting up the Gorki KHW makes it possible to shut down 285 heating plants in the city, with heating powers between 0.3 MW and 500 MW. Such a route should have considerable associated consequences as regards the reduction of environmental pollution (11).

In the GDR, KHWs will be erected to a larger extent only after the year 2000. The time period that remains until then should be used to create the required preconditions by expanding the remote-heating networks. The following problems must be considered here:

- Over a rather long period of time, KHWs will be used only to take over the base load in the range from 30 to 70 percent of the design power of the network. Conventional installations will continue to be needed to cover peak loads.

- Industrial consumers are currently being supplied in many cases with steam that has high parameters. The choice of parameters is often determined not by the technological process in which the heat is used but rather by the type of heat generation. One can start from the idea that a major portion of the heat demand can also be satisfied with hot water as the heat medium. For the remaining processes, where steam is necessary for technological reasons, the possibility suggests itself of generating steam nearby with hot water as the heat source. If high-parameter steam is needed, its parameters can be improved by means of thermal compression (12).

- The integration of major heat sources into the remote heating networks can create problems of supply reliability for the connected consumers, especially when the heat source makes up more than one third of the installed power. This problem can be made less severe by the use of heat storage facilities. The breakdown of the heat source can be bridged over by storage facilities, at least for a certain period of time. The storage facilities furthermore can be used to cover the peak heat demand and thus can contribute towards increasing the working load on the nuclear heat source and thus towards improving its economy.

- Several remote heating networks of the GDR are designed for flow temperatures of 180° C. If it should prove necessary to retain such a high flow temperature even in the future, the heat medium will have to be further heated by conventional means when KHWs are used in these networks, at least during times of high power demand.

Considering these special features of nuclear heat sources, it is posible in the long term to create the conditions for effectively deploying this heat source.

Studies have been performed at the College of Architecture and Building Construction at Weimar (14) concerning the heat demand in two areas of the Thuringia area. Results of these studies confirm this general conclusion. For both areas, the economic appropriateness of using a KHW of type AST 500 in a mono-block arrangement to cover the rising heat demand could be demonstrated, especially by comparison with other variants. These studies furthermore showed that the industrial steam demand represents a relatively small portion of the overall heat demand. Thus, the preconditions exist for using secondary steam generation with subsequent thermal compression.

Various requirements have been placed for KHWs of low power, for instance, to supply heat to cities with 20,000 to 50,000 inhabitants. From an economic point of view, these requirements currently cannot be sustained. Low-power KHWs are associated with very high specific costs, if they are to possess the same parameters for the heat medium as KHWs of type AST 500. A clear cost reduction occurs when the parameters are reduced. This tends to reduce further

the distance between the KHW and the consumer, which is required for reasons of nuclear safety.

In the extreme case, a reduction of parameters leads to a pressureless reactor, as with the Canadian KHW of type SLOWPOKE. The reactor exit temperature of the coolant is then 85 to 90°C, the flow temperature in the heating loop is only about 70°C. Low-temperature heat with such parameters is not useable for industrial purposes. It presupposes special heating systems. To this must be added that KHWs of a small power class would have to be erected in very large numbers to be able to render a substantial contribution towards relieving the consumption of raw brown coal. Need areas of the size we have mentioned would, for an extended period of time, continue to be supplied from heat sources utilizating raw brown coal, unless they could be integrated into larger remote-heat networks. The use of heat pumps in such areas appears possible if the following preconditions are fulfilled:

- reserves in the national electric power supply
- heating systems at the required temperature level
- availability of a heat reservoir that is useable for effective operation.

6. Conclusions

These considerations on the long-term development of the heat supply in the GDR results in requirements whose implementation must be prepared during the present development stage.

The future heat supply requires designs which permit the creation of complex solutions for public and non-public areas. The degree of centralization of the remote heating systems must be increased by the coupling of individual heat-supply regions within metropolitan high-density centers. Here, the integration of industrial heat consumers and the increase of the remote-heating portion in communal areas are especially important.

In the industrial sector, the increased use of hot water as a heat medium should be emphasized. By selecting the location of KKWs under the perspective of the maximum possible coupling-out of heat, and by intensively preparing for the use of KHWs with reactors of type AST 500, the utilization of a steadily increasing portion of nuclear heat sources for the remote-heat supply is to be assured.

Footnotes

(3) CEMA Seminar "Nuclear Heat Supply", Vols. 1 and 2. October 1983. Moscow, USSR.

(4) Bouska, J., Kremia, J., and Fizal, S.: The conception of the perspective use of nuclear heat sources in the CSSR. CEMA Seminar "Nuclear Heat Supply", October 1983, Vol. 1, p. 44.

(5) Herrmann, D.: Social-economic aspects of the further expansion of the remote heat supply. 16th Power Plant Engineering Colloquium of Dresden Technical University, October 1984 in Dresden, Lecture V6.

(6) Sokolov, J.N.: Possible applications of low-temperature heat generated in reactors of type AST 300 and AST 500. CEMA Seminar "Nuclear Heat Supply", October 1983, Moscow, Vol. 1, p. 7.

(7) Herrmann, D., Reetz, B., and Schmidt, G.: Problems of economic introduction of large heat sources into developing heat-supply systems. IAEA Seminar "Nuclear Heat Application", December 5-9, 1983, Krakow, Poland.

(8) Herrmann, D., Lutzow, K., Reetz, B., and Ziegenbein, D.: Some requirements for the development of the remote heat supply from the perspective of the future deployment of nuclear heating plants, Kernenergie (Nuclear Energy) 26 (1983) pp. 54-58.

(9) Brede, O., Nagel, S., and Ziegenbein, D.: The developmental status of nuclear installations with organically cooled reactors. Kernenergie (Nuclear Energy) 27 (1984) pp. 221-226.

(10) Hermann, D., et al.: The technology and economy of the broad utilization of nuclear heating plants with a block power up to 500 MW in the GDR. Study, Center for Nuclear Research at Rossendorf, June 1982.

(11) Pleskov, G.J. and Saprykin, J.M.: The centralized heat supply system based on the nuclear heating plant at Gorki. CEMA Seminar "Nuclear Heat Supply", October 1983, Moscow, Vol. 1, p. 54.

(12) Reetz, B.: Possibilities and limits of steam compression. 16th Power Plant Engineering Colloquium of Dresden Technical University, October 1984 in Dresden, Lecture V25.

(13) Reetz, B.: Nuclear energy installations for heat supply in the GDR. Dissertation (B), Technical University Dresden, 1984.

(14) Langner, A.: Studies concerning the utilization of remote heat supply with nuclear heating plants in the population network of the GDR. 16th Power Plant Engineering Colloquium of Dresden Technical University, October 1984, in Dresden, Lecture V5.

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8348

ARGENTINA

CNEA PRESIDENT OUTLINES NUCLEAR PROGRAM

PY211706 Paris AFP in Spanish 0609 GMT 21 May 85

[By Luis Maria Maiz]

[Text] Buenos Aires, 21 May (AFP) -- Despite the budget cuts imposed because of the serious economic crisis, the Argentine nuclear program will not be paralyzed and will go ahead with the objective of improving the well-being of the people rather than the power of the state, National Atomic Energy Commission (CNEA) President Alberto Constantini has said. In an exclusive interview with AFP, Constantini reported that during a recent meeting with President Raul Alfonsin, it was pointed out that it is necessary to apply nuclear energy to peaceful uses. The use of radioisotopes in nuclear medicine and industry shall testify to the truth of this assertion. Radioisotopes are used not only in medicine, biology, and biochemistry but also in food preservation, in the production of nitrogen fertilizers, in the improvement of livestock, and in several engineering and industrial processes, particularly in metallurgy. Constantini stressed determination to make every effort to carry on with the application of radioisotopes project, so that everybody will know that the CNEA is working for the health and the economy of the people. In an apparent allusion to the previous military administration (in power between 1976 and 1983), Constantini said that the CNEA used to represent the power of the state from the military viewpoint and from the viewpoint of domination. Rather than the power of the state, now we want it to represent the well-being of the people, he remarked.

Constantini explained that the energy production issue was discussed with the president and that the pace of the projects will be set by economic possibilities and energy needs. Argentina has two nuclear plants, Atucha I and Embalse. The Atucha II plant is under construction. Atucha II is scheduled to begin operations in 1990. Thus, it will be necessary to produce heavy water, which will be used as a moderator (of natural uranium reactors), to implement the expansion of prospecting and contraction plans, and to carry on with the fuel production program. This is why we are undertaking parallel efforts, and we will obviously have to develop the proper technologies for these three areas -- fuel, moderator, and the element that generates electric power -- he said. After admitting that the Atucha II project suffered a 6-month delay this year, mainly because the 1985 national budget will not be approved until July, Constantini said the plant will begin operating in 1990 if an additional investment is made to compensate for the delay, and provided we do not reach the project's critical stage. Alfonsin also stressed the need to preserve human resources. Therefore, priority treatment will be given to all of the areas of the research and development program.

In summary, on the basis of our reasoning, of the support for the sector, and of the importance of research, human resources, the application of radioisotopes, and our

participation in the electric power centrals, we can conclude that no part of the nuclear plan can at this moment be halted, Constantini stated. Therefore, construction of the experimental heavy water plant will be completed, although a $10-million investment is still needed for completion. The Tander project (the Tandem Argentino, a heavy ion research accelerator) will be completed. The uranium enrichment program will also continue.

Constantini said that this policy will be ratified by Alfonsin in a message he will deliver on 31 May, Atomic Energy Day, in the southern city of Bariloche. Constantini reported that the presidents of the Latin American Energy Commissions have been invited to come to Bariloche that day to issue a statement in support of the peaceful uses of atomic energy, particularly in the field of medicine.

At the same time, he announced that the Applied Research Institute, INVAP, a state-run company whose scientific personnel b long to the CNEA, will build a bulk container for cobalt and the first locally made cobalt therapy equipment. The CNEA chairman recalled that the same group of physicists who succeeded in mastering the uranium enrichment process in the Pilcaniyeu experimental station 2 years ago is working in INVAP. On the other hand, perhaps as a way to alleviate the serious problem of the low salaries being paid to the technicians, CNEA scientists will be transferred to another state corporation recently established, High Technology [ALTEC], to develop a microcomputers project.

With regard to cooperation with other countries, Constantini recalled that technical cooperation agreements are in force with virtually every country in Latin America, but that they are more effective with Brazil, Uruguay, and Chile and that there are very intense and friendly ties with Bolivia in the field of nuclear medicine. Constantini stated that an agreement was reached with Colombia to build a reactor (zero power type, for research) there as has been done in Peru.

The problem in the case of the Latin American countries is that this type of cooperation requires Argentine financing, something that is hard to achieve owing to the economic situation in the country, Constantini admitted. Nevertheless, an effort is being made to export technology to other Third World countries and maybe we will close a deal which we will make public in due time, by the end of May, Constantini said. In the case of the PRC, where several missions have been sent, Constantini said that their main interest lies in obtaining the fuel cycle (a technique achieved by Argentina) because they will build several nuclear power plants.

Asked about a feasibility study to build a nuclear-powered submarine (which was started during the military regime after the Malvinas war), Constantini revealed that the study continued for 3 months under the current regime and then was paralyzed owing to budgetary restrictions. Constantini made it clear, however, that the project has not been discarded since a reactor like the one that was to be developed, with 15 megawatts of power, may be of interest as an energy source for remote or inhospitable areas because it does not have to be refueled for 5 years and eliminates the large high-tension powerline systems. Such a reactor would be especially useful in jungle or forested areas of Brazil or Peru. Therefore, the idea of developing a prototype has not been ruled out, Constantini concluded.

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ARGENTINA

NUCLEAR PRIORITIES OUTLINED IN REPORT TO CONGRESS

PY012045 Buenos Aires NOTICIAS ARGENTINAS in Spanish 1335 GMT 1 May 85

[Text] Buenos Aires, 1 May (NA) -- The budget for the development of nuclear activities this year will be subject to the same restrictions as in 1984 "because of the persistently difficult economic-financial situation of the country, with the consequent assigning of priorities." This was stated in the report annexed to President Raul Alfonsin' inauguration message to the regular session of Congress.

The priorities of the nuclear plan were summed up in the following points:

"1. To preserve the human resources of the National Atomic Energy Commission (CNEA), since this is the resource most difficult to replace.

"2. To disseminate throughout the country the various uses of radioisotopes and radiation for the benefit of the economy and the health of the population.

"3. To maintain the tempo of the projects already under way, whenever possible within the limitations of the credits which can be assigned to them."

President Alfonsin stressed that despite the budget restrictions for the nuclear plan, the CNEA could meet the following objectives in 1984:

1. The preservation of its highly trained human resources;

2. The continuation of its research and development programs;

3. The intensification of the use of ionization radiation in the interior of the country for the benefit of regional economies, through the signing of agreements with San Juan and Mendoza Provinces for the preserving of local foodstuff products by means of irradiation;

4. The increase in the use of radioisotopes in their various fields of use in medicine, agronomy, veterinary treatments, industry, and basic research;

5. The intensification of the application of nuclear medicine in the fields of diagnosis and therapy through a program which not only permits the constant application of the knowledge in the field, but also makes it possible to provide the necessary equipment for the benefit of the health of the population;

6. The extraction of the first bars of Cobalt 60 from the reactor of the Embalse nuclear centre which has made Argentina the fourth largest world producer of the product;

7. The continuation of the projects in the energy sector which, because of budget restrictions, have had to be delayed;

8. The continuation of the building project of the Peruvian atomic center and the fulfillment of all international and bilateral commitments regarding delivery of goods, training of personnel -- particularly in Latin America -- and making experts available.

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ARGENTINA

AATN DEEPLY CONCERNED OVER FUTURE OF NUCLEAR PROGRAM

Buenos Aires CLARIN in Spanish 17 Apr 85 p 20

[Test] Argentine nuclear program industrial suppliers of the National Commission for Atomic Energy [CNEA] have charged that the state is $100 million in debt to them; that they are "on the verge of suspending payments," and that because of this, "a reduction has begun that will affect the source of employment of some 20,000 Argentine families."

Fifty-four private enterprises making up the Argentine Association of Nuclear Technology [AATN] have called attention to the situation which is affecting 14,000 of their employees, as well as 6,000 others who belong to the CNEA. AATN head Raul Andres Boix Amat, who is also manager of nuclear projects for Techint, S.A., (one of the major contractors for the Atucha II civil works) pointed out that in some cases arrears in payments go back to August 1984, and that CNEA has acknowledged the debt, but upon appeal to the Treasury seeking payment, it was denied them.

The association stated that layoffs at the rate of 400 a month have begun and added that the sector has been the victim of specific discrimination by the state, because even if the CNEA budget allocation amounted to less than 5 percent of the Treasury's outlays, the commission now owes more than 20 percent of the overall debt incurred by the Treasury.

The commission also referred to the loss of scientists and technicians that is "beginning to take place," due to the "discouraging prospects of progress on the horizon" experienced by those "who made possible the technical and industrial development that has placed our country among the most advanced in the world."

The association said that it issued warnings a year ago about the "impending crisis" and that it now has to "point out the seriousness" of the situation and propose measures to "prevent the dismantlement of the sector." Among other things, the association stated that "the most drastic budget cut in the history of the nuclear sector activity took place in 1984," but that this was further compounded by the fact that CNEA "received less than one-third of the 1984 budget allocation," and that this situation "did not change in the first 3 months of 1985, causing an unprecedented financial suffocation."

Referring specifically to the Atucha II project, Boix Amat said that the rate of progress there is extremely slow.

Program

After pointing out that he is not "unaware of the seriousness of the economic situation and that he was not joining the struggle unleashed by other economic sectors for allocations," the association again insisted that "the nuclear sector is being discriminated against in the assignment of budget funds," and that it proposed eight measures:

1. promulgation of specific legislation expressing national interest in the peaceful uses of nuclear energy;

2. drafting of a realistic intermediate and long term nuclear program to assure economic independence and overall development, adjusting the timetable of accomplishments to budgetary possibilities and private investment capacity;

3. establishing budgetary controls to prevent overspending and a reduction in the flow of funds;

4. restoring the confidence of producers and investors by the timely payment of incurred obligations and preventing the encroachment by the state in activities which, by their very nature, are most effectively handled by the nation's private sector;

5. maximizing private efforts to conserve the technological level already attained;

6. insuring the correct use of installed nuclear power generation capacity;

7. optimizing the use of available resources;

8. providing incentives to productivity in the sector, promoting its exports and maintaining a respectable wage structure.

12674
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ARGENTINA

NUCLEAR PROJECTS 'PARALYZED' BY LACK OF RESOURCES

PY201515 Buenos Aires NOTICIAS ARGENTINAS in Spanish 2045 GMT 19 May 85

[Text] Buenos Aires, 19 May (NA) -- Raul Boix Amat, president of the Argentine Association of Nuclear Technology, asserted that the "current situation is dramatic" for the sector, but added that if the project to build four atomic plants were carried out, "it would be certain that financial aid could be obtained from the private sector."

Boix Amat stated that the sudden cut in the budget of the National Atomic Energy Commission [CNEA], which fell from $1.2 billion in 1981 to only $200 million in 1984, has prompted the paralyzation of important nuclear projects. Boix Amat noted that "if the approval of this year's budget continues to be delayed, the reactivation of the nuclear industry will be postponed another year." In this regard he added that "although we still do not know how much money will be allocated for this sector in 1985, according to the figures that have been leaked we will not be able to maintain a reasonable work pace" and added that "there are already three paralyzed projects: the heavy water experimental plant, the uranium enrichment plant, and the radio-chemistry laboratories, recyclying nuclear fuel. Also, only some of the work at the Atucha II plant is being carried out."

After acknowledging that "the government is doing its best with the country's scarce resources," the nuclear official stressed that "the Radical government must realize that the nuclear field is about to yield important economic results" and that "it may soon start to generate a strong support for the export of goods and services." In this regard Boix Amat explained that "so far the country's nuclear development has been basically technological" and that practically all technologies necessary to have an independent nuclear program have been mastered, but that the industrial development is just starting."

Boix Amat said that the nuclear development so far has represented nothing but expenditures, "but that now the sector could start to yield economic benefits;" therefore, "this possibility must not be thwarted." Boix Amat said that currently Argentina is in a position to "export reactors for the production of radio isotopes and for atomic plants," and that "regarding nuclear energy power plants we can associate with international enterprises."

Regarding the prospects that the Argentine nuclear technology has in the PRC market, he said that "there are concrete possibilities in the case of the fuel cycle, for example" since, he asserted, the PRC Government "is very interested in this field." Boix Amat explained that nuclear development in the PRC "is based on the requirements established

for the use of nuclear energy for strategic purposes, which are quite different from those for the use of nuclear energy for peaceful purposes, especially regarding its economy and the safety of the plants."

Boix Amat ended by stating that the Argentine nuclear development "has entered the industrialization phase, in which the economic criteria must be granted priority treatment; therefore, private investments must be sought that will yield goods and services -- irradiation plants, and cobalt treatment factories -- that may be exportable."

CSO: 5100/2107

BOOK ON NATIONAL ATOMIC ENERGY DEVELOPMENT RELEASED

PY131455 Paris AFP in Spanish 0728 GMT 11 May 85

[Excerpt] Buenos Aires, 11 May (AFP)--It has just been released and is already promising to become a best-seller [given in English] even though it is a scientific book which, at the same time, represents a valuable contribution to the history of Peronism, for many years the leading force in Argentine politics and now the opposition party at congress.

The 288-page book, entitled "The Huemul Atomic Secret," was written by Mario Mariscotti and has been published by the Sudamericana-Planeta Publishing Company in Buenos Aires.

The book, classified as a chronicle of the development of atomic energy in Argentina, was written by Mario Mariscotti, the current director for research and development of the National Commission for Atomic Energy [CNEA]. It begins with the sensational announcement made on 24 March 1951 by then-president of the republic, General Juan Peron.

According to Peron's announcement, thermonuclear reactions under technically controlled conditions were produced at the atomic pilot plant on Huemul Island, San Carlos de Bariloche, in southern Argentina.

CSO: 5100/2105

ARGENTINA

BRIEFS

CNEA REDISTRIBUTES FUNDS--Between 80 and 100 million dollars of the 4.2 billion (thousand million) earmarked for completing construction on Atucha II and the Arroyito heavy water plant will be redistributed to other areas within the National Atomic Energy Commission (CNEA), according to express instructions from President Raul Alfonsin, who also said he was keeping on Alberto Constantini as president of CNEA. Constantini, who made the announcement, said finishing work on those two projects would thus be pushed back about six more months, but the cutback would "not affect other projects, such as the uranium enrichment plant in Pilcaniyeu, R&D (research and development) and other programmes." The 70-year old CNEA president said the president would hear nothing of the resignation he had offered in light of the reshuffling going on in state firms and promised "the flow of funds to CNEA will not suffer the interruptions which have upped costs ten-fold and paralyzed work projects." Alfonsin will "ratify his support for the CNEA and the current nuclear programme" in a national message on May 31 in Bariloche, commemorating Atomic Energy Day and the 35th anniversary of CNEA. [Text] PY110135 Buenos Aires BUENOS AIRES HERALD in English 10 May 85 p 9]

NUCLEAR POLICY SCORED--Members of the "Group of Six" stated that if the 1985 National Budget for atomic energy were to be approved, the meager funds allocated to the National Commission for Atomic Energy would be insufficient to meet operational needs. They added, "in plain language, the proposed 1985 budget allocation for nuclear powerplants should be put in the rubbish heap, inasmuch as they imply nonprovision of funds to continue projects that have been delayed, to pay for needed future and undelayable projects, and to maintain operations of the nuclear sector at economically profitable levels, a situation which its chairman, Alberto Constantini, anticipated as being an insoluble dilemma." Finally, after having discussed technical accounting matters, the Peronista bloc's report "proposes a public hearing by the Budget and Finance Committee of the Chamber of Deputies to discuss the prospects facing nuclear development because of the present form of the 1985 National Budget bill. [Excerpt] [Buenos Aires LA PRENSA in Spanish 10 Apr 85 p 6]

SUPPORT FOR NUCLEAR PRIORITIES--Cordoba, 17 May (TELAM)--Alberto Constantini, chairman of the National Atomic Energy Commission [CNEA], has revealed that on 31 May, Atomic Energy Day, President Raul Alfonsin will deliver a message of support for the Argentine nuclear plan and will announce a common Latin American front for the use of this energy for peaceful purposes. In remarks to the newspaper LA VOZ DEL INTERIOR, Constantini added that because of economic restrictions the programs of the nuclear plants will not be able to maintain their pace, but explained that the remainder of the nuclear plan will not be affected. He stated that the priorities established will be met in due time. For example, human resources are our number one priority. Research and development comes immediately afterward, followed by the plan for the use of radioisotopes in medicine, industry, agriculture, and other fields, while the last point in our priorities refers to energy problems, that is, to the nuclear plant electricity production. Constantini added that scientists will not feel frustrated or forced to migrate to other parts of the world, and that the presence of President Alfonsin at the ceremony marking Atomic Energy Day to be held on 31 May will show the real support that is being given to the CNEA. [Text] [Buenos Aires TELAM in Spanish 1415 GMT 17 May 85 PY]

CSO: 5100/2107

BRAZIL

ANNOUNCEMENT OF NUCLEBRAS, CNEN HEADS STILL PENDING

Sao Paulo O ESTADO DE SAO PAULO, in Portuguese 27 Mar 85 p 31

[Text] The nuclear sector is virtually halted while waiting for names to be picked to head up Nuclebras and the National Nuclear Energy Commission, its two principal agencies. In the case of Nuclebras, two names are being considered, the most likely being the director of Petrobras, Paulo Belotti, in addition to the ex-minister of education, Ney Braga. For the National Nuclear Energy Commission, the name most frequently mentioned up to now has been that of Jose Israel Vargas.

Paulo Belotti left yesterday for Brasilia to meet with the authorities of the energy sector, as well as Dario Gomes, the current chairman, who went to meet with the secretary-general of the Ministry of Mines and Energy, Paulo Richer, "to discuss the extremely serious problems facing Nuclebras, which is out of funds to pay suppliers and contractors and can't afford to take on any job at all," according to advisers of the government-owned company.

In October of last year, the financial situation of Nuclebras was already very difficult, and if it had been a private company it would have filed for bankruptcy. Since then, the company's financial situation has grown even worse, with only enough funds on hand to meet the payroll of its 5,000 employees spread among its six subsidiaries. Work on projects in the sector, which was already very slow and uneconomical, has now stopped altogether.

Besides the lack of financial resources, the nuclear sector faces difficulties also with the access to Angra dos Reis, where mudslides on the Rio-Santos highway have practically blocked off the Angra II and III nuclear construction sites.

Belotti

The financial director of Petrobras, Paulo Belotti, yesterday termed as speculation the news that he would be nominated by the Minister of Mines and Energy, Aureliano Chaves, to the presidency of Nuclebras. Belotti said he had not been invited and that for the time being, he was staying on at Petrobras.

Paulo Belotti had been the candidate of former President Geisel for the presidency of the government-owned petroleum company but had been passed over in favor of Helio Beltrao, candidate of the Liberal Front Party for the governorship of Rio de Janeiro.

The use of gas for thermal power in the region, he says, is advantageous in both economic and environmental terms, since it is nonpolluting.

With regard to the generation of power at Itaipu, the president of CESP explained that a price equal to that of power supplied by the Furnas power company (Furnas Centrais Eletricas S.A.) has been agreed upon. CESP will thus continue to generate 90 percent of its needs, while purchasing 10 percent from Furnas, under contract running through 1987, and still buy 48 percent of the capacity of Itaipu. Meanwhile, he still sees no problem with excess energy, since Itaipu is operating on a test basis through the end of the year.

12430
CSO: 5100/2092

BRAZIL

GOLDEMBERG CITES CONSIDERATIONS IN REEVALUATING PROGRAM

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 10 Apr 85 p 22

[Text] The position of Mines and Energy Minister Aureliano Chaves, favoring completion of Angra I and II nuclear power plants and possibly Angra III and then reevaluating the whole nuclear program, is what the scientific community has been defending for many years, especially prof Jose Goldemberg, president of CESP [Sao Paulo State Energy Company]. In his view, Aureliano Chaves has not used President Tancredo Neves's illness as an excuse to get out of dealing with the nation's problems, nor has he ducked comments on one of the most controversial subjects in the energy area.

However, Goldemberg points out that reevaluation of the nuclear program must take three factors into account: the financial cost, the enrichment of uranium, the technology for which cannot continue to be centralized in the government's keeping, and the real need for nuclear energy. Experience shows, according to Goldemberg, that nuclear power costs three times more than hydroelectric power, besides the fact that the whole program is being carried out with foreign credit.

Up to now, US $4 billion have been spent, mostly with German financing, and Goldemberg estimates that the cost of all eight plants will run to US $30 billion. Because of that, he stresses that it is necessary to have a look at other energy options, such as gas in the north, coal in the south, and hydroelectric wherever possible,besides the question of rationalizing the whole system.

The professor points out that there is already a consensus that the country must master uranium enrichment technology. But that, he says, means a change in the government's stand, "since technological development is carried out in universities and not in closed governmental research institutes. Furthermore, technological development does not have to mean buying nuclear reactors or equipment."

As for another polemic brought up by the minister of mines and energy on the construction of the Balbina hydroelectric plant, 150 kms from Manaus, Goldemberg offers a suggestion. He points out that the plant will involve flooding an area larger than that of the Tucuri project of some 2,000 square kilometers and he launches the idea of using gas from Jurua, the largest reserve in the country, located 600 kms from Manaus.

Deficit

He said that he went to discuss energy problems with minister Aureliano Chaves. As for the company's operating deficit, supposedly caused by petroleum increases and the rate of exchange not keeping up with each other, Belotti said that the spread is around 1.3 trillion cruzeiros. The way for Petrobras to get that money, according to Belotti, would be to issue treasury notes with the same maturity as the company's long-term debt.

12430
CSO: 5100/2092

PERU

DAILY CONCERNED OVER BRAZILIAN NUCLEAR PROJECT

PY112105 Lima EL COMERCIO in Spanish 30 Apr 85 p A2

[Editorial entitled: "Undesirable Nuclear Presence in South America"]

[Text] A dispatch datelined Sao Paulo, Brazil, reports on the possibility that Brazil may possess by 1990 its first nuclear bomb or, at least, by then it will be in a position to manufacture the deadly device.

The report was published by the newspaper FOLHA DE SAO PAULO in Sao Paulo and citing "a former military minister" as its source, elaborates on the status of the project and the places where work is being conducted.

The report states that both the Brazilian Navy and Air Force are involved in this project. The navy is carrying out nuclear research at the Institute for Nuclear and Energy Research [IPEN] on the Sao Paulo University campus, while the Air Force Technological Center [CTA] near Sao Paulo.

The dispatch also mentions two places where the nuclear tests might take place. One is in the Amazon Region, south of Para State, and the other, the Martin Vaz Island, a small island located 1,200 km from the continental coast.

According to FOLHA, Brazilian military circles justify this project as a means to confront the pressure exerted by the developed countries that are trying to prevent the Third World countries from having access to the complete nuclear cycle.

It is quite likely that this information is true in view of such precise details, and taking into account the fact that Brazil has not signed the Nuclear Non-Proliferation Treaty.

Moreover, Brazil has made considerable progress in developing the required nuclear technology. It already has a fully operational nuclear plant that was built by Westinghouse, and has signed a long-term agreement with the FRG that will allow it to have another eight nuclear plants, a plant to enrich uranium, and one to reprocess nuclear fuel in the near future.

It has been stated that all this infrastructure will allegedly be destined for nuclear energy uses for peaceful purposes, and that there is no reason for

further doubts. But the information we have points out the possibility of Brazil manufacturing a nuclear bomb, a matter which, undoubtedly, causes concern and is not in keeping with the spirit of the Tlatelolco Treaty, signed by our country, through which it is agreed that the Latin American sub-continent will not use nuclear energy for belligerent purposes and will devote its greatest efforts to the peaceful use of the atomic power.

The fact that neither Brazil nor Argentina have signed the mentioned agreement may lead us, if the news that Brazil will produce an atomic bomb is true, to a dangerous arms race on this continent.

CSO: 5100/2106

VENEZUELA

CNIN TO MANUFACTURE RADIOACTIVE ISOTOPES FOR INDUSTRIAL USE

Caracas BOHEMIA in Spanish 29 Apr-5 May 85 pp 50-51

[Excerpts] Venezuela's only reactor is located at the IVIC [Venezuelan Institute of Scientific Research]. There is a considerable variety of possible reactor designs. The RV-1 is a light water reactor. This type of reactor is used commercially in the United States, and is also the type most commonly used all over the world.

At the present time preparations are being made so that the RV-1 reactor at the "Romulo Betancourt" CNIN [National Nuclear Research Center] may begin to manufacture radioactive isotopes for the petroleum industry, for industry in general, medicine, and of course, for research purposes.

Until the present the Pipe reactor has been used to conduct research. Work has been done with isotopes and the center has qualified staff capable of doing this work. It is now planned to produce these isotopes for commercial purposes. This will offer Venezuela both economic and technical advantages, as our nation will acquire more experience in this field. These isotopes are used for treating cancer, leukemia, and thyroid problems.

The initial investment in the radioactive isotope plant is estimated at 5 million bolivars, a very small amount when compared with the foreign currency savings that will be generated. The strong demand for radioactive isotopes in Venezuela is concentrated in several specific areas: Technetium 99, Iridium 192, and Iodine 131.

Radioactive waste disposal is another issue causing much alarm in Venezuela; to soothe the fears of some concerned persons, the Health Radiation Physics Laboratory of the Physics Center is dealing with the protection of personnel working there, in addition to ensuring the proper handling of such wastes, in order to prevent the occurrence of any unfortunate incidents.

Venezuelan citizens like the biologist Edgar Gonzalez and the chemist Juan Diaz say that Venezuela's facilities and industries are radiologically safe. They claim that Venezuela can acquire the professional expertise to work with this type of material. It is true that much still remains to be done in the nuclear field in Venezuela, but it is essential to take the first steps.

It is a fact that for the foreseeable future the option of choice will be nuclear fission. Let's hope that the radioactive isotope production plant will be built rapidly, as that plant may mean a certain advance into Venezuela's nuclear age.

7679
CSO: 5100/2101

SOVIETS SAID TO HAVE DEPLOYED SS-20 NUCLEAR MISSILES

Tehran KAYHAN INTERNATIONAL in English 8 May 85 pp 1-2

[Text] New Delhi, May 7 (Dispatches)--Western diplomats said Tuesday that they had reports from diplomatic, Iranian and Afghan sources that the Soviet Union has deployed SS-20 nuclear missiles in Afghanistan, but the reports could not be confirmed.

The diplomats told Reuters they had learned some of the medium-range missiles had been stationed at the remote, top-security Soviet airbase in Shindand, 450 miles (725 km) west of the Afghan capital of Kabul.

"But we have no firm independent evidence that rockets have been stationed in Afghanistan," said one of the diplomats, who spoke on condition they not be identified.

The diplomats quoted diplomatic sources in Kabul as saying SS-20s had been deployed at Shindand.

Another report of SS-20 deployments was contained in an Iranian government newspaper that quoted a Beijing radio dispatch in February, the diplomats said. The Chinese radio cited claims by a former major of the Afghan air force that nuclear missiles had been stationed at the Shindand airbase.

Similar reports were broadcast by radio station Voice of the Islamic Revolution of Afghanistan, the diplomats said.

Not New, Never Were

The Soviet army newspaper Red Star has denied all of the reports.

"There were no SS-20 missiles in Afghanistan in the past, nor are there any such missiles now," the newspaper said on April 24, according to Xinhua, the official Chinese news agency.

The Soviet base at Shindand was reinforced considerably during the Iranian hostage crisis in 1980, when the Soviets feared U.S. military intervention across the border, the diplomats said.

Security around Shindand is tight, they said, and there are no reports of insurgent activity in the area.

Outlining recent military developments in Afghanistan, a diplomat said Islamic guerrillas had attacked the airport at Jalalabad, 75 miles (140 km) east of Kabul, on April 23. Six people were reported killed and 10 injured.

On April 27, guerrillas attacked Soviet forces near Jalalabad, destroying three tanks and killing or wounding 15 Soviet soldiers, the diplomat said.

The guerrillas are battling to topple the government of President Babrak Karmal, which is being backed by an estimated 115,000 Soviet troops. Soviet troops invaded Afghanistan in December 1979.

CSO: 4600/452

ANALYST EXAMINES FEARS OF INDIA DEVELOPING BOMB

Madras THE HINDU in English 7 Apr 85 p 2

[Article by G.K. Reddy]

[Text]

IT is very difficult for a fledgling nuclear power like India to convince the world that its atomic research is intended only for peaceful uses and not for military purposes. The country's intentions became suspect after the explosion of its first nuclear device in 1974, although India continues to swear that it will not make nuclear weapons.

The big powers continue to question India's nuclear objectives because it has not only refused to sign the Nuclear Non-Proliferation Treaty (NPT) but also declined to submit its entire nuclear programme to fullscope safeguards under more comprehensive international inspection. At present the International Atomic Energy Authority is entitled to inspect only the American, Canadian and French aided nuclear installations like the Tarapur and Rajasthan power plants and heavy water units. The rest of India's nuclear programme, including the research reactors, reprocessing and fuel fabrication plants, the atomic mineral deposits, experimental laboratories, fast breeder units, variable cyclotrone, design establishments and test sites are outside the purview of international inspection.

The critics of India's nuclear activity think that this poor country cannot afford the luxury of employing over 10,000 highly skilled scientists and workers on this gigantic effort merely to achieve self-reliance in harnessing atomic energy for peaceful uses: this knowledge could be acquired from other nuclear powers at a fraction of the cost, so the argument runs. If it had really no intention of utilising this capability for making nuclear weapons at some stage.

Space programme

The parallel attention that India has been devoting to a simultaneous development of its space programme has made these critics suspicious that, in addition to carrying on secret research on development of both nuclear and thermo-nuclear processes, India is also trying to develop delivery systems. The fact that India is making its own solid fuel propellants and building ballistic rockets for launching experimental satellites has only added to the prevailing misgivings abroad that the country is fully poised to emerge as a nuclear weapon State at a politically opportune moment to safeguard its strategic interests.

What then is the actual position? Is India quite earnest about its repeated declarations that it will never make the bomb or will it exercise the option if neighbouring Pakistan acquires nuclear weapons? A good many countries abroad seem to believe that there is a credibility gap between India's relentless campaign against nuclear proliferation and retention of its sovereign right to make the bomb for its self-defence, if Pakistan were to pose a nuclear threat to it.

The apprehension that India might emerge as a nuclear power at a moment of its choice, thereby throwing the floodgates open for several other countries to follow suit, has made many in the West jump to the conclusion that it is only a matter of time before India casts off the fig leaf and becomes a nuclear weapon State. The big powers see something sinister in the extension of India's research activity from fission technology for harnessing nuclear energy to the complexities of fusion methods of generating thermo-nuclear power, because it gives India the capability for making the hydrogen device.

Implied insinuation

It is argued that once the engineering problems of developing a dependable trigger mechanism, along with an alloy metal casing capable of containing the enormous heat at the core till the flashpoint has been reached for the big explosion, are mastered by the Indian atomic experts, it should be possible for India to leap forward from nuclear to thermo-nuclear age. The critics tend to jump to the conclusion that, sooner or later, the very dynamics of

power politics in Asia and the big power rivalries in the region would leave a country like India with no alternative except to exercise this option.

But what is conveniently overlooked, in raising this bogey of India developing secretly the capacity to make both nuclear and thermo-nuclear bombs under the guise of harnessing the atom for peaceful uses, is that almost all countries with a nuclear capability are working on what is called the magneto-hydro-dynamics (MHD) technology for using the so-called fusion method instead of the fission system for generating abundant electric power in future. The general assumption is that a country working on the fusion technology would automatically acquire the capability for making the hydrogen bombs, even if its main intention is to use this method only for power generation.

The implied insinuation is that, having developed the capability for making a Hiroshima type of fission bomb, India is now logically working on a hydrogen bomb based on fusion technology to transform itself in due course from a fledgling nuclear power into a full-fledged thermo-nuclear weapon State. The repeated Indian assurances that it is not trying to acquire either fission or fusion bombs have not helped to dispel the feeling abroad that the country is striving hard to achieve this dubious distinction.

Financial constraints

The budgetary allocations for India's scientific programmes are not much more than Rs. 1,000 crores a year, although its research activity in the fields of nuclear and space development is quite wide-ranging and, therefore liable to be mistaken for a professedly peaceful programme with military overtones. In a country with the third largest scientific manpower in the world, it is not surprising if 10,000 persons are engaged in India's nuclear development. The fact remains that, at its present level of development, India is in no position to divert its scarce resources from economic development to the acquisition of nuclear and thermo-nuclear weapons.

A successful test explosion of a hydrogen device will not automatically make India a thermo-nuclear power, just as the 1974 test did not make the country a nuclear weapon State. It will have to spend many billions of rupees spread over several years to master the technological complexities of exploding the hydrogen protons, then designing the device in a deliverable size to be dropped from an aircraft or launched with a ballistic missile with all the accompanying paraphernalia of guidance and monitoring systems to become a thermo-nuclear State.

So it is totally inconceivable that, amidst its many domestic political preoccupations, financial constraints and international commitments, India would embark in the foreseeable future on a crash programme of making nuclear or thermo-nuclear weapons at the cost of subordinating its economic development. But at the same time it cannot afford to follow an ostrich-like policy of shutting its eyes altogether to the realities of neighbouring Pakistan acquiring the bomb and posing a threat to it.

So the big powers believe that India will continue to steer a middle course by pressing ahead with its research and development of atomic energy for peaceful uses within the limits of the financial allocations made for this purpose, while utilising the knowledge so gained for updating its capabilities of exercising the nuclear option at some point of time in future should the need arise for it. The ambitious Indian nuclear power programme for generating 10,000 MW by the end of this century has made many in the West react with a combination of admiration and suspicion about the significance and consequences of it.

The first experimental nuclear reactor was built in India indigenously as far back as 1956, which was the only one in Asia at that time. The second one with Canadian collaboration was completed in 1960, while the third and fourth ones were built by Indian atomic scientists in 1961 and 1972 without any outside assistance. The fifth one, a 100 MW reactor, one of the largest experimental reactors in the world, is nearing completion. The two reprocessing plants in operation as well as the fuel fabrication unit, besides the uranium mining operations have been designed, built or developed entirely by Indian scientists along with other supporting systems for operating the full fuel cycle.

The fuel wastes of the Indian experimental and power reactors, altogether 13 at present run mostly with natural uranium U-235, except the Tarapur power plant built with U.S. collaboration which uses enriched uranium, are capable of yielding about 50 to 100 kg of plutonium U-239 a year, half of which is of weapons grade purity, and this would be augmented considerably by the turn of this century when India's fast-breeder reactors go into commercial operation.

There is thus no doubt that India has the material resources and technological skills to embark on both nuclear and thermo-nuclear weapon programme, if it is compelled to do so by force of circumstances. But what is important is that the country has no intention of doing so because of the many physical constraints besides moral compulsions.

In the initial stages, India used to proclaim that it regarded the bomb as an evil and would never go in for nuclear weapons. But this stance was subsequently changed with the qualification that, though it had no intention of doing so at present, no Government in a democratic society could commit the future generations without taking into account the contingent situations that might arise in course of time. This redefinition of policy implies quite clearly that, while India is not going back on its earlier commitment not to acquire nuclear weapons, it is not abandoning for ever the right to do so in self-defence at some point.

It is this subtle distinction in the current articulation of Indian policy, coupled with the sustained efforts of the country to make rapid strides in its nuclear and space programmes, that has led to the widespread feeling abroad that India is secretly working on the development of nuclear and thermo-nuclear weapons as well as delivery systems.

The country is poised to achieve a substantial self-reliance capability by the end of this decade in designing and building multi-stage ballistic rockets, remote sensing and communications satellites, monitoring and guidance systems for putting in orbit different types of space vehicles. This will enable the country to develop medium range nuclear tipped missiles in another decade. It is the rapid advances being made by India in space technology that has surprised many of the country's critics abroad, who had otherwise reconciled themselves to the thought of the possibility of its crossing the nuclear threshold at any time of its choice.

At present India is working on a nuclear power programme of 10,000 MW by the turn of this century, with its total reserves of uranium in the indicated and inferred categories estimated at 73,000 tons. It is enough to support a nuclear power generation at this level for at least 30 years, before the fast-breeder technology is mastered and the world eventually switches over to the fusion system in another 50 years for almost unlimited power supply in future.

But during the intermediate stage, India, like all other countries, would have to rely on fast-breeder reactors to make up for depletion of uranium resources to produce more plutonium for establishing an estimated power generation capacity in the range of 3,50,000 MW. As far as India is concerned, the fuel of the future for its nuclear power programme is thorium extracted from the monazite sands available in abundance on its south coast.

At one stage India sought the technical cooperation of Japan in developing thorium technology, but Tokyo did not want to get involved in it when India was locked in a running controversy with the U.S. over the proposed fullscope safeguards on its entire nuclear programme. The U.S. went back on its agreement to supply enriched uranium fuel for the Tarapur plant on the basis of the existing safeguards, if India was not prepared to submit to comprehensive restrictions on its entire nuclear programme in the name of non-proliferation.

It is quite possible that India might revive the offer to Japan which should accept it unreservedly, since the thorium fuel cycle is the only one that produces non-weapon grade plutonium without any risks of proliferation.

Science management

The nuclear programme has given India considerable experience in science management, which has enabled it to extend its research activities into many other inter-related spheres. There are 22 major nuclear installations and another 26 subordinate scientific establishments engaged in this multi-dimensional activity, ranging from agricultural and medical research, application of lasers, seismography and radiation physics to molecular biology, radio astronomy and computer sciences.

It has also enabled India to acquire special knowledge in microwave technology, solid state physics and development of special alloys and metals of high purity like titanium and zirconium. And if all this knowledge is invaluable in the exercise of the nuclear option at short notice, it is equally useful in industrial applications for the good of the Indian people.

CSO: 5150/0016

INDIAN REACTION TO 'NUCLEAR PAKISTAN' DISCUSSED

New Delhi PATRIOT in English 7 Apr 85 p 5

[Article by K. Subrahmanyam]

[Text]

In his interview to the Nawai Waqt of Rawalpindi, Dr A Q Khan made it clear that Pakistan has reached uranium enrichment capability and if their government were to so decide, Pakistani scientists were in a position to make the bomb. Pakistan, according to Dr Khan, has achieved the technological capability in regard to uranium enrichment reached so far only by the US, USSR, France, China and UK and the consortium of three European states (UK, West Germany and Netherlands). In this respect, Dr Khan pointed out that Pakistan has overtaken India.

He is justifiably proud that Pakistan achieved the same in about seven years' time what took the European consortium 20 years. General Zia-ul Haq on his return from Moscow said to the press on 15 February that Pakistan had acquired "a very modest" research and development capability in the enrichment of uranium.

Obviously, when Dr Khan brackets Pakistan with the five nuclear weapon powers and claims reaching the capability attained by the European consortium after 20 years, he would not be taking of a "modest R and D capability". Further, according to Dutch government documents, Pakistan had imported 6000 centrifuge tubes by 1979. And there is the reference to Pakistan's capability to produce a nuclear weapon if a decision were taken.

From all this, one would be justified in inferring that Dr Khan and General Zia were both trying to communicate to the world that Pakistan has started production of enriched uranium of weapons grade in industrial quantities. There have been a number of reports over the last three-four years of Pakistan's clandestinely acquiring equipments needed to produce the trigger device. It will be a fair assumption that such efforts had been pursued by Pakistan along with their efforts to master the technology of enriching uranium to weapon grade. Pakistan has not so far conducted a test on its soil. The reports about a seismic event in the Ras Koh region in mid-1983 related to a natural earthquake with epicentre 30 km below the surface are well-known.

What made Dr Khan make his public statement? To argue that he was provoked by excerpts from the book **Islamic Bomb** published in a Pakistani journal appears simplistic. Dr Khan has a long record of keeping silent and not being easily provoked. Nor it is a casual event for such excerpts appearing in a Pakistani journal. We have to, therefore, seek alternative explanations.

[ ]

In fiscal year 1984-85 Pakistan is one of the countries listed to benefit from the liberalisation of terms of financing of weapons purchases from the US. Why would Pakistan publicly announce its reaching the enrichment capability and thereby endanger its arms relationship with the US? One has to look into the benefits of strategic ambivalence in regard to nuclear policy for its answer.

Pakistanis may volubly attack Israel and the Zionists, but in reality Israel acts as a model for Pakistan. Both states were born out of the two-nation theory, and Pakistanis consider themselves as a martial and chosen people just as Israelis do. Israel has successfully adopted the strategy of ambivalence. As far back as in January 1973 the President of Israel made it public that Israel was in a position to make nuclear weapons. Intention to do so was subsequently denied but it was asserted that Israel would not permit any other Arab country to be the first to introduce nuclear weapons. Though according to Israeli litera-

ture that country has arsenal of more than 200 weapons, they have not carried out a test since the days when tests started getting monitored internationally. Because of this strategy of ambivalence the US excuses itself for not invoking the US nuclear Non-proliferation Law against Israel. The Pakistanis are today attempting to place themselves in the same category as Israel to test whether the US would invoke the Non-proliferation Law against it. At the moment Pakistan appears to be favourably placed to apply leverage on the US in this respect. Last year Pakistanis created some alarm within the US administration through their indirect negotiations with Kabul. With the happenings in Lebanon, the strategic cooperation agreement with Israel, and its inability to compel Iran to agree to termination of the Gulf war, US credibility in the Arab world is not high, nor is Arab morale. Hence the value of Pakistan to the US is relatively higher now than it used to be.

Early in April 1978 the Indian Foreign Minister first disclosed in Parliament that Pakistani nuclear efforts had non-peaceful dimensions. This was the first official announcement to the world of Pakistani bomb effort, though earlier in the autumn of 1968 in the British Parliament the question of supply of inverters to Pakistan that could be used in the centrifuges had been raised. A few days after the disclosure in the Indian Parliament came the announcement of the Carter administration that it was invoking the Symington Amendment and cutting off all aid to Pakistan other than the food aid. Then came the Panorama TV programme of the BBC, the Dutch parliamentary commission's report on the A Q Khan affair, the lengthy debates in the US Congress on the waiver of the Symington Amendment and extension of arms aid, the book **Islamic Bomb**, hints from Washington about a Chinese-Pakistani link up on the nuclear programme and speeches of US officials on the possibility of Pakistan reaching nuclear capability. In India too, over the last five years there have been a number of books, articles and monographs on whether Pakisten will succeed in going nuclear. All these helped to condition the people of the subcontinent to accept the recent announcements of Dr Khan and General Zia on Pakistan attaining uranium enrichment capability without excitement or panic.

The last four years since the publication of **Islamic Bomb** by Maj Gen D K Palit and P K S Namboodiri have seen considerable debate in this country on the strategic and political implications of Pakistan going nuclear. Some of it was redistillate of western conventional wisdom, but some of it was professional. The Armed Forces indicated their concern by having a seminar in the United Services Institution and postal seminar in the College of Combat. The present, when Parliament is to debate our defence efforts, is an appropriate time to have a dispassionate, objective and unsentimental assessment of what a nuclear Pakistan implies for Indian security.

Since Pakistan has reached the uranium enrichment capability, it is to be assumed that they will be in a position to build up an arsenal of uranium bombs constrained only by the output of their centrifuge plant. In other words, as years go by, Pakistan will be able to have several bombs widely dispersed over a number of locations. Pakistan's delivery system will be aircraft, and the F-16 now being acquired, is designed as a nuclear-weapon carrier though it is difficult to say at this stage whether Pakistanis have as yet been able to design a weapon within the weight range that can be fitted to the F-16. But they have other aircraft as well. The first untested uranium bomb dropped over Hiroshima weighed a few tons and since then technology has made it possible to make weapons within much smaller weight ranges. In that respect plutonium lends itself to miniaturised bomb-making in a relatively more versatile fashion than uranium.

Prof. Stephen Cohen, who discussed with the Pakistani military establishment the rationale of their nuclear-weapons programme as far back as early 1980, had recorded their arguments. According to them, a Pakistani nuclear capability would "neutralise an assumed Indian nuclear umbrella under which Pakistan could reopen the Kashmir issue; a Pakistani nuclear capability paralyses not only the Indian nuclear decision but also Indian conventional forces and a brash, bold, Pakistani strike to 'liberate' Kashmir might go unchallenged if the Indian leadership was weak or indecisive". It is in this connection one has to pay particular attention to Pakistan acquiring a vertical envelopment capability by integrating its armed helicopters with its army, developing the Skardu airfield and logistical network backed by the Karakoram Highway.

The best use of nuclear weapon is not to explode it on any target but to exploit its political utility. The nuclear weapon has been converted into a currency of international power, thanks to the legitimacy conferred on it by the Non-proliferation Treaty. Pakistanis have in the past proved themselves skilful in probing into the weaknesses in Indian defence and taking full advantage of them. The Kutch operation and the Chhamb sector are two such examples. A nuclear Pakistan will be in a position to take similar advantage of any weaknesses in the long Indian defence line and placing India in a dilemma of either escalating the conflict with possibility of involvement of use of nuclear weapons or negotiating under adverse conditions. It is not possible in an article like this to go into greater details of the military implications of the asymmetric situation of Pakistan having nuclear weapons and not India.

Then there are the political implications. The scheme of SARC (South Asian Regional Cooperation) will assume a somewhat different character if Pakistan becomes explicit member of the Nuclear Club or even adopts a strategy of ambivalence and lets other nations

of the subcontinent realise through subtle hints that she is in possession of an undeclared nuclear arsenal. Under such circumstances one wonders whether Pakistani or Bangladeshi Foreign Ministers will take the Indian Foreign Minister in confidence if they were to receive a future request for troops from Sri Lanka.

Many, both inside and outside India, assert that following the 1974 Pokhran test India must have built up a limited nuclear arsenal; very often this is cited to justify Pakistani nuclear weapon programme. The Indian nuclear test of 1974 triggered off may developments in respect of international nuclear relations. The advanced nuclear industrial nations formed the London Club and formulated a trigger list of items not to be exported. The peaceful nuclear explosion which was until then extolled as a major beneficial application of constructive use of nuclear energy was projected as being no longer cost effective. The US came out with its own Nuclear Non-proliferation Act.

All the above developments were the direct outcome of the Indian nuclear test. Yet, significantly, the penalties of the US Non-proliferation Act, invoked in the case of Pakistan in April 1979, were not applied to India. This could only mean that the US administration which monitors the nuclear activities of all nations could not conclude that India had built up a nuclear arsenal, however, small. India certainly is not a "favoured client" of the US, which Israel and South Africa are. Washington has taken an unhelpful line even in respect of reprocessing the reactor-grade Tarapur plutonium. Every now and then a story is planted in the US media about some digging activity in Pokhran and they are used to justify disowning of their contractual obligations by the US administration and their Congressmen. While in Pakistan's case the US administration has to waive the application of the Symington-Glenn Amendment to their Non-proliferation Act, such a contingency had not arisen in India's case.

Therefore we have to start with the assumption that in spite of the Pokhran test of 1974 India has at present no nuclear arsenal. It has no doubt demonstrated the capability to build one at short notice. A serious limitation is the availability of weapon grade plutonium. Contrary to the disinformation put out by the US and western strategic literature the Tarapur and Rajasthan reactor-grade plutonium is totally worthless to make usable weapons. Hence our production capacity of Plutonium 239 necessary for weapons is limited by the CIRUS reactor output. When the new reactor Dhruva is commissioned it will augment our output. The capability building up an arsenal is within our capabilities and since we have carried out a test it is also possible for the Indian scientific establishment to build similar plutonium devices without further testing, though further improvement in design and going on to thermonuclear stage will not be easy without a series of tests specifically aimed at improving yield-to-weight ratios. Till now the Indian leadership has adopted the line that while India would not rule out further nuclear explosions if they were considered necessary to develop peaceful application, it is not intended to build weapons.

It is obviously not in India's interest to become an overt nuclear weapon power in response to Pakistani policy of ambivalence, for that itself will provide Pakistan justification to declare itself a nuclear weapon power. On the other hand the Indian objective should be to use Pakistani overt nuclear declaration to justify its own programme. At the same time Pakistan should not be left with any doubt that India would not allow an asymmetric situation to develop. In the past, both in 1965 and 1971, misperceptions on the part of Pakistani leadership led to their adventurism against India. Consequently, the Indian response should also be a policy of ambivalence with enough hints to create an impression that the Indian policy is no longer one of total nuclear abstinence. To borrow a phrase from the Israelis, India should project an image that she may be having some bombs in the basement with the last wire yet to be connected; thus technically not being a nuclear-weapon power but for all practical purposes being one.

The Pakistani strategy of ambivalence and that of India are different. Pakistan has attempted to create an impression that it has reached the stage of producing a weapon by announcing its enrichment capability. India on the other hand has to communicate to the world that she may have shed some of her inhibitions in regard to development of nuclear arsenal. This is somewhat more difficult since this involves a reversal of image that has been built up over a period of time, while in the Pakistani case it was an announcement long expected.

How does one carry out a strategy of ambivalence in respect of nuclear capability in the case of India? It is not feasible to discuss in an article those actions intended to convey to the world, especially to those who are monitoring the nuclear developments, the uncertainty that there may be some discontinuities in our policy of nuclear abstinence. But two steps can be publicly discussed.

First, our practice of singing in chorus, that India will never go nuclear and that the nuclear energy will be used solely for peaceful purposes should be replaced by different leaders of government speaking in different voices, while perhaps the Prime Minister should continue with the established declaratory policy pronouncements. At the next level there could be nuances of changes in regard to public pronouncements. For instance, the customary answer of the Defence Ministry that all developments that have a bearing on our

security are monitored and necessary steps are taken to meet all contingencies could be modified to indicate a slight change. This is only by way of example and it is not necessarily recommended that it should be specifically done. Speeches of senior leaders could encompass the nuclear threat to the country and emphasise that our neighbours should not think in terms of nuclear blackmail and that India would be able to meet it. There should be greater encouragement to public discussions, seminars, publications, including those with participations of senior service personnel and ex-service personnel on the likely nuclear threats and steps to avert them. A little more attention to these issues in our military training institutions will be desirable. Some discussions on the civilian command and control in nuclear war contingency in the subcontinent will generate certain messages augmenting ambivalence. Our official policy at the highest level will continue to be to assert that India will not consider use of nuclear energy for purposes other than civilian.

There will no doubt be many well-intentioned idealists who will be horrified by this strategy of ambivalence. They will once again recommend that Inaia should join Pakistan in an arrangement for mutual inspection and for renunciation of nuclear weapons. Underlying such approach is an implicit acceptance that Indians and Pakistanis cannot handle nuclear weapons and nuclear strategy without dropping the bomb on each other. The assumption in this article is that Pakistanis are not less rational than the westerners and they will not take undue risks if they do not woefully miscalculate. The way the generals like Ayub Khan and Yahya terminated the wars showed that their risk-taking propensities were constrained by rationality. General Zia, if at all, has shown himself to be very much shrewder, much more calculating and far less inclined to risk-taking. To a large extent it is the self-obsession of the Indian elite which leads them to think that the sole justification for Pakistani nuclear effort is in India.

Bhutto called the nuclear capability the "sword of Islam". Ali Mazrui has written about nuclearisation of Islam. Francis Fukuyama of the Rand Corporation has said: "Acquisition of nuclear weapons is very much bound up with Pakistan's self-conception as the leader of the Islamic world". It is a matter of national consensus in that country.

Therefore, our aim should be to devise ways and means to deter Pakistan from taking undue risks. We may not in fact subscribe to the doctrine of deterrence; but to take steps to deter someone, it is not necessary to be a believer in that doctrine, just as one need not be religious to respect other's religious susceptibilities. So long as Pakistanis and the rest of the world believe in deterrence doctrine, it should be possible for us to deter them.

CSO: 5150/0017

DEFENSE PLANNERS URGED TO ASSUME PAKISTAN HAS BOMB

Bombay THE TIMES OF INDIA in English 22 Apr 85 p 8

[Article by K. Subrahmanyam]

[Text] THE defence ministry's annual report for 1984-85 has, for the first time, focussed attention on the nuclear factor in the Indian security calculations. The Prime Minister has also been making references to this issue and it is time the issue is examined objectively.

So far there have been two approaches to this vital question — either to express pious horror towards nuclear weapons and talk of excluding the weapon from the subcontinent or to denounce vehemently the Pakistani quest for nuclear capability and thereafter lapse into masterly inactivity without any further thought to what the impact of Pakistani nuclear capability will be on Indian security or how we should respond to the challenge posed by it.

General Zia-ul-Haq, with consummate skill, has been playing on the emotions of our Cliveden Set by offering them mutual inspection of nuclear facilities or nuclear weapon free zone and such other "pie in the sky" proposals even as he presses on with his weapons programme.

The basic parameters must first be recognised. Pakistan has no use for enriched uranium for a peaceful programme and Pakistani effort to get a reactor has been completely thwarted by other nations. The Pakistani uranium enrichment programme is not an R and D programme but an industrial scale one. Its friend, the U.S., had to give a permanent waiver from the Symington amendment to Pakistan — the only country in the world to which such a waiver has been given — to make it eligible to receive military and economic aid under U.S. law though the U.S. administration has information to show that Pakistan is pressing on with its quest for weapon capability.

Indeed, the U.S. administration has clearly indicated that it is in no position to give assurances to Congress that Pakistan is not going ahead with its nuclear programme. Further, according to the information published by the the eminent scholar-journalist Mr. Leslie Gelb, the U.S. administration has not been able to send down its multi-billion dollar nuclear reactor deal with China, the centre-piece of achievement during President Reagan's visit to Beijing, for ratification to Congress because of the intelligence available that China has passed on to Pakistan the design of its fourth bomb test.

In these circumstances, to act on any assumption other than that Pakistan has already achieved or is about to achieve nuclear capability will be the height of irresponsiblity on the part of our security planners.

Unequal Bargain

There will no doubt be some people who would urge that India should accept the Pakistani leadership at its word and work for avoidance of nuclear weapons in the subcontinent. That will be like the advice given by people like Rajaji, Mr. Kripalani and Mr. Dhebar in the fifties to reduce the defence expenditure and they were the first to denounce the government for its credulity and negligence when disaster befell us in the wake of the Chinese attack in 1962.

Preaching sanctimonious sentiments in favour of peace costs nothing to those who have no responsibility for national security. If anything goes wrong they can always have an alibi and say that the government did not furnish adequate information at the right time.

Only those who are totally ignorant of what mutual inspection of each other's nuclear facilities mean in practice are taken in by the beguiling offer of General Zia. Once certain facilities capable of producing fissile materials have been in operation for some time (and they have been both in Pakistan and India) there is no way of having a foolproof inspection *expost factor* which will give confidence that some fissile materials had not already been converted into bombs in the basement.

There are no standard IAEA procedures for inspection of a uranium enrichment facility. The two such facilities which are under nominal IAEA inspection (Urenco and Eurodif) are under self-inspection procedures of Euratom. They are based on the fact that they are operated on a multi-national basis. To work out such procedures for a national facility will take years of negotiations and at the end of it all there will be no certainty there are not some bombs in the basement. Further, mutual inspection between India and Pakistan—two countries at very different levels of development in nuclear technology — is an unequal bargain from the Indian point of view. In a sense it is a revival of the old Congress-Muslim League parity syndrome.

The south Asian nuclear free zone proposal of Pakistan is an attempt to make India renounce the nuclear option and make the entire subcontinent an area vulnerable to Chinese hegemony. As the Muslim League tried to promote British interests against the freedom struggle, so the Pakistanis are now attempting to promote the Chinese interests against the subcontinent. Even Mr. Morarji Desai, when he was Prime Minister, rejected the nuclear weapon free zone proposal as a backdoor move to legitimise the arsenals of the five nuclear weapon powers.

Mutual Deterrence

In these circumstances, the realistic course of action is to examine ways and means of coexisting peacefully with a nuclear Pakistan which, because of its nuclear capability, is likely to be more self confident and less paranoid about its insecurity. It is downright racialism and a servile "Uncle Tom" approach to argue that nuclear weapons in the hands of Pakistan are likely to be less responsibly used than those in the hands of a senile Mao Tse Tung, an unstable alcoholic Nixon or a dying Brezhnev, Andropov or Chernenko. The city busting and genocidal bombing are part of European and American strategic thought while the wars in the subcontinent, unfortunate as they are, have been conducted with due deference to laws of war.

Those who talk of high costs of nuclear armaments are living in the world of fifties. Today compared with conventional aircraft (costing Rs. 20 crores a piece) the nuclear armaments are less costly. Investments on modernisation of command control and communication will have to be undertaken whether a country goes nuclear or not. Both India and Pakistan have made the basic investments on nuclear technology and what will be needed will be additional marginal investments. The projection of allegedly high costs of nuclear arsenals are part of a deliberate disinformation campaign on the part of the established nuclear powers and their allied crypto-nuclear weapon powers.

Experience in Europe and east Asia during the last four decades reveals that so long as the major powers of the world believe in the doctrine of deterrence, Kiraz Atom is able to maintain peace according to the accepted belief of the industrialised world.

The doctrine of deterrence, like many religious dogmas, may be neither provable nor unprovable. What really matters is whether the strategic thought of today, as accepted by the dominant nations of the world and their politico-military establishments, is governed by the doctrine of deterence or not. It is and this cannot be ignored.

Though the nuclear weapon powers and their allies account for nearly 82 per cent of the world military expenditure, produce well over 90 per cent of armaments and have far more contentious issues likely to lead to conflict among them, there has been peace among the nuclear powers and their allies. There is no reason to believe why the situation between India and Pakistan, if both acquire nuclear arsenals, should not get stabilised on the basis of mutual deterrence in a similar way.

Rational Course

Pakistan is not likely to test its weapons so long as it has to get conventional arms and economic aid from the U.S. The uranium weapon which Pakistan has been after does not require testing to have confidence in its effectiveness to the same extent as the plutonium weapon using the implosion technique does. The U.S. did not test the uranium bomb in 1945 and dropped the first pro-

totype it built on Hiroshima with full confidence that it would explode. Besides there is the American information of the Chinese helping the Pakistanis with the weapons design.

Under these circumstances, it is not going to be possible for any Indian leadership responsible for the national security of the country to persuade itself that Pakistan has no bombs in the basement. Therefore the rational course will be to accept that Pakistan may have them and fashion an Indian policy of deterrence *vis-a-vis* such a threat.

At one time U.S. strategists used to emphasise the factor of certainty in projecting deterrence. The USSR met this challenge with secrecy and signals causing confusion which were adequate to deter the U.S. through uncertainty. Of late various nations, including the U.S. are using elements of uncertainty, along with their established capability to deter their adversaries. The argument in favour of the Strategic Defence Initiative is essentially that acting as a filter of warheads it will create enough uncertainty for the adversary to deter him from considering a disarming first strike. Deterrence through uncertainty is nurtured by a posture of ambiguity. Israel and Pakistan are today practising this strategy of ambiguity effectively. The ambiguity is caused by creating a strong impression of one's capability and vehement public denials of it, thereby transmitting two contradictory signals to the adversary. The U.S. administration by not being in a position to reassure its own Congressmen that Pakistan has not acquired or is not on the way of acquiring a nuclear capability reinforces the Pakistani strategy of ambiguity.

This extremely sophisticated strategy of Pakistan has to be countered by a similar strategy by India. We start with an initial advantage of having conducted the Pokharan test and our ability to produce weapon-grade plutonium. At the same time, India has been certified by the U.S. as not having built an arsenal since there has never been any thought of applying the Symington amendment to India as President Carter did to Pakistan in 1979.

This certainty about India's nuclear abstinence and the uncertainty about Pakistan's nuclear capability tend to create an asymmetry of deterrence with all consequent disadvantages to India in politico-strategic terms. This asymmetry needs to be rectified immediately by increasing the uncertainty about our status.

CSO: 5150/0021

GANDHI'S REMARKS ON NUCLEAR THREAT REPORTED

Remarks on Nuclear Threat

Delhi Domestic Service in English 4 May 85

[Excerpt]

Mr Rajiv Gandhi has said that the country has to face the challenge posed by agitations, some of which are openly aimed at weakening India's unity and integrity. Speaking at the All India Congress-I Committee [AICC-I] which began a 2-day session in New Delhi today, he said the people must close their ranks and fight as one the problems facing the country.

He said India feels that Pakistan is developing a nuclear weapon. India is not convinced that all the powers that could stop Pakistan are in fact trying to do that. Mr Gandhi declared that we are looking into various aspects of this to see what action we could take.

BBC on Gandhi Remarks

London BBC World Service in English 4 May 85

[Text]

The Indian prime minister, Mr Rajiv Gandhi, has said his government is considering what action to take in the light of definite reports it has received that Pakistan is going ahead with the development of nuclear weapons. Mr Gandhi said it was a dangerous development by Pakistan which would completely change the military balance in the subcontinent. Pakistan has repeatedly denied that it is manufacturing nuclear arms. Mr Gandhi's remarks came in a speech to his Congress Party in Delhi from where Mark Tully sent this dispatch:

[Begin recording] This is the first time he has indicated that the new government is even considering the nuclear option. India does have a sophisticated nuclear program and did indeed explode a nuclear device 11 years ago. But the government has

always been saying that the whole program including the one explosion is peaceful. In recent years, these assurances have on the whole been internationally accepted. Pakistan maintains that its nuclear research program is also peaceful, but there has been considerable skepticism about this in Western countries as well as India.

It's possible that Mr Rajiv Gandhi is attempting to put pressure on America to take a tougher stand on Pakistan's nuclear program. He told his party conference: We are not convinced that all powers that can do so are trying to stop Pakistan developing a nuclear weapon. This seems to be an indirect reference to President Reagan's decision to supply arms to Pakistan in spite of doubts in Washington about that country's nuclear program.

Rajiv Gandhi is due to visit America next month and one of the main points he will bring up is the threat to India which, he maintains, the rearmament of Pakistan represents. [end recording]

Defense Minister on Statement

Delhi Domestic Service in English 4 May 85

[Excerpt]

Speaking on the resolution on international affairs at the AICC-I session, [Defense Minister] Mr P.V. Narasimha Rao clarified a short while ago that it will be wrong to interpret that India has been reviewing its policy on nuclear energy. He said the remark by Mr Rajiv Gandhi this morning has been misinterpreted by some overenthusiastic newsmen. The interpretation was not warranted. Mr Narasimha Rao said that he had the support of Mr Gandhi in making this clarification. Mr Gandhi was present at that time.

The resolution was later unanimously adopted. Mr Narasimha Rao appreciated the concern expressed by a number of speakers over reports of Pakistan acquiring nuclear capability. He assured them that the government is fully alive to these dangers. But as the government, we cannot react to every news item about these developments. India has to have a certain amount of defense preparedness based on its needs regardless of what its neighbors may acquire. India does not have to match them on a weapon-to-weapon basis, but on the basis of matching a system with a system.

Mr Narasimha Rao said that the whole country is one with regard to our foreign policy which is based on the principles of peace and nonalignment. Stressing the need for cooperation among various countries, he said the only way to exist in the world today is to coexist. He said the big powers talk of disarmament but go on adding to their arsenals. The huge amount which they spend on armaments can be diverted to development.

Gandhi Says Remarks Twisted

Delhi Domestic Service in English 5 May 85

[Excerpts]

The 2-day session of the All India Congress-I Committee ended in New Delhi this evening with an affirmation by the party president, Mr Rajiv Gandhi, that the party will never deviate from the path of socialism. The affirmation was also made in the economic resolution, which was adopted unanimously earlier in the day. Resolutions on women and youth were also adopted before the session concluded.

Mr Rajiv Gandhi said a news agency makes its own interpretation to some of the remarks he made yesterday about Pakistan's nuclear program and what India will do in this regard. After twisting his remarks, they openly told him that they had themselves interpreted what he had said. It is by such acts, particularly on matters concerning national policies, that the press gets the bad name. Are they responsible, he asked.

CSO: 5100/4749

AEC CHAIRMAN INAUGURATES INDO-FRENCH MEETING

Calcutta THE TELEGRAPH in English 2 Apr 85 p 8

[Text]

Bombay, April 1 (UNI): The Atomic Energy Commission chairman, Mr Raja Ramanna, today said that fast breeder nuclear reactors were far cheaper as they produced more fuel than they burnt.

Inaugurating a four-day Indo-French seminar on nuclear energy here, Dr Ramanna said nuclear generation was well suited to India as it was cheaper than thermal energy even at the pithead stage.

He said a few reactors would be going critical soon and expressed confidence that Indian industry would gear itself to build components for the future generation of nuclear reactors.

Dr Vendryes, a senior French nuclear scientist, in his remarks, said India and France were among the first to build nuclear cooperation for peaceful purposes. But that process slowed down and come to a halt.

He said there were differences in the types of nuclear technology obtaining in the two countries but both had a similar policy on nuclear uses.

. Participating in the seminar, the nuclear power board chairman, Dr M. R. Srinivasan said the success of the 10,000 MWE nuclear power programme required much greater attention than shown till now by Indian industry.

The concept of bulk ordering, as in France, was being adopted to provide continuity of orders for a series of components for the next six reactors.

The capital on the programme, though large, was only a fraction of the investment needed for attaining a target of 150,000 MWE by the end of the century, he said.

With the establishment of a 10,000 MW nuclear capacity based on natureal uranium resources, adequate plutonium would be produced annually, making it possible to add 1,000 MW of fast breeder reactors every year, Dr Srinivasan observed. This plutonium, together with the uranium 238 left over from the 10,000 MWE programme, make it possible to put up 350,000 MWE of fast breeder reactors within next century. "This is the target set for our fast reactor programme," he said in a special paper.

As a second phase, the Indo-French 15 MWE fast breeder test reactor was nearing completion at the research centre at Kalpakka, he added.

Dr Srinivasan said the experience generated at Kalpakkam had encouraged Indian scientists to prepare a feasibility report for a 500 MWE prototype fast breeder reactor while taking up supporting activities like fuel fabrication and spent fuel reprocessing.

A facility for manufacturing plutonium fuel elements for the fast breeder reactors has been set up at Trombay. The plutonium-uranium carbide fuel elements needed for startup of the reactor has also been fabricated, along with thorium oxide fuel elements.

CSO: 5150/0014

INDIA

FRENCH NUCLEAR ENERGY TEAM VISITS KALPAKKAM

Madras THE HINDU in English 7 Apr 85 p 12

[Text]

MADRAS April 6

The leader of the visiting French atomic energy delegation today expressed the hope that cooperation between the two nations now limited to specific areas of research would develop and expand into the field of nuclear power generation.

Dr. George Vendryes, Director and senior advisor to the French Atomic Commission, told newsmen after a visit to the Kalpakkam atomic energy complex that common fields of interest were identified at a seminar held earlier this week in Bombay where the two sides presented their proposals for future reactor designs and related fuel cycle activities.

"We are both interested in the development of the fast breeder reactors," he said. The fast breeder programme in India was of great interest to French scientists because it will use plutonium carbide fuel, which no one else has attempted to do before. The carbide fuel had many advantages. "We are satisfied with the plutonium oxide fuel but who knows what the future holds", he said.

Dr. Vendryes added that while India had preferred to build heavy water reactors rather than the light water reactors which France had standardised on, there were still common topics where exchange of information would be beneficial.

Asked whether in the wake of a Russian offer to sell light water reactors to India, France was also keen to offer theirs, Dr. Vendryes said that if India, having chosen the heavy water reactor line, was still interested in building light water reactors, the French would surely sell them.

Smaller reactors. Although France had standardised designs for the large 900 MW sets and was now building the larger 1,300 MW sets, it could supply smaller reactors to suit the grid conditions in India. (The French nuclear plant equipment manufacturers are represented in the delegation).

Dr. Vendryes said that about 58 per cent of the energy consumed in France last year came from nuclear sources. By 1990 the share of nuclear energy would rise to 70 per cent.

There were 40 nuclear power units in operation and another 20 were under construction. But further expansion was likely to be slow as the rate of increase in the demand for energy was not as much as expected.

Nuclear safety. On nuclear safety, Dr. Vendryes claimed that the track record of the French was perfect. "No one has even been injured," he said. This record was impressive when one considered the whole production chain in coal fired plants. "The number of people killed in coal mines is not negligible," he said.

There was an anti-nuclear lobby in France but people living around nuclear plants were the ones most convinced about the safety of these stations.

Mr. K. S. N. Murthy, Director, Madras Atomic Power Station, told newsmen that the station was generating 225 MW of power. The vibration in the turbine, which authorities tried to correct during the three month outage earlier this year, was still there. But Mr. Murthy said that the unit would be run for another two months before further repairs were attempted.

CSO: 5150/0015

INDIA

AUSTRALIAN NONPROLIFERATION SUGGESTION REJECTED

BK081339 Melbourne Overseas Service in English 1230 GMT 8 May 85

[Text] India has rejected Australian suggestions that it consider joining the nuclear nonproliferation treaty and gives support to Australian initiatives for a comprehensive test ban treaty.

The foreign affairs minister, Mr Hayden, had earlier put those propositions to India's junior foreign minister, Mr Khurshid Alam Khan.

However, in meetings in New Delhi with senior Indian officials, Mr Hayden was told that, while India would not sign the treaty, it did adhere to its provisions. The Australian minister was told that India did not want nor had any intention of acquiring nuclear weaponry.

Mr Hayden, who is making his first official visit to the region, expressed his concern at the armed buildup of both India and Pakistan and the possibility that both could acquire nuclear weapons.

Radio Australia's correspondent in New Delhi, John Mills, says India's response has been expected. India has a significant nuclear power industry and in 1974 exploded a nuclear device.

Mills says also within the short meeting with India's finance minister, Mr V.P. Singh, Mr Hayden was told that India needed to remove some of the major obstacles to freer trade with the outside world.

Our reporter says trade between India and Australia is worth about $250 million [currency not further specified] a year, and there is interest from both countries in increasing this.

Mr Hayden is also due to meet India's prime minister, Mr Rajiv Gandhi.

CSO: 5100/4752

INDIA

IMPORTANCE OF FAST BREEDER REACTORS TO NUCLEAR PROGRAM

Madras THE HINDU in English Survey of Indian Industry 1984 pp 85, 87

[Article by Dr C. V. Sundaram, director, Reactor Research Center, Kalpakkam]

[Text] THE first stage of the Indian nuclear power programme has been essentially based on pressurised heavy water reactors (PHWRs). In this reactor system, heavy water is used both as moderator to slow down the fast neutrons released in uranium fission, and as coolant to extract the fission heat. The principal attraction of this type has been that the reactor can be fuelled with uranium of natural isotopic composition (with 0.71 per cent of the fissile isotope U-235, the rest being U-238). (Uranium-235, which undergoes nuclear fission on neutron capture, is the only naturally occurring 'fissile' material. Uranium-238 and Thorium-232 are more abundant 'fertile' materials, which on neutron irradiation in a reactor, get transmuted to fissile materials, namely Plutonium-239 and Uranium-233.)

With the successful commissioning and operation of the first unit of the Madras Atomic Power Station at Kalpakkam (Tamil Nadu), PHWR technology has attained a state of maturity in indigenisation in our country, and this has also given the confidence to project a total nuclear power generation capacity of 10,000 MWe to be installed by the year 2000. In addition to power generation, one of the important benefits accruing from the regular operation of PHWRs is the progressive availability of plutonium as a very valuable by-product from the transmutation of the more abundant uranium isotope U-238. The technologies for extraction of plutonium from the irradiated uranium fuel and for the fabrication of a variety of plutonium bearing fuels, have been systematically evolved through research and development and plant operations at Trombay over the past two decades. The stage has now been set for the effective utilisation of plutonium in what are known as Fast Breeder Reactors (FBRs), which will form the second stage of the Indian nuclear programme, providing the real key for the full utilisation of the country's uranium resources and preparing the way for the long-term utilisation of the more abundant thorium resources.

Higher fissile content fuel

The design of fast breeder reactors—where the fission reaction is sustained through the agency of fast neutrons—is in many ways different from that of water-cooled thermal reactors. On account of the absence of the moderator, the fast reactors require fuel of higher fissile content which may vary from as much as 60 per cent or more in reactors of smaller size to around 15-20 per cent in large reactors of commercial size. For the same reason, for comparable power levels, the reactor core volumes will be much smaller in fast breeder reactors with corresponding increase in power density. This requires a more efficient coolant for extraction of heat from the reactor core. The higher neutron yield from the fast fission of plutonium and the relatively smaller loss of neutrons through parasitic capture result in a better neutron balance in fast reactors, enabling the generation of more fresh fissile material than is consumed during reactor operation. In a PHWR, plutonium generated will be around 0.8 kg for every kg of Uranium-235 consumed. In a large FBR, fresh plutonium produced (from Uranium-238) will be around 1.2 kg for every kg of plutonium consumed, and the nett surplus will enable the

setting up of additional FBRs. This is the crucial advantage of the fast breeder reactor.

An analysis has shown that if the Indian nuclear power programme is confined solely to natural uranium reactors, the known uranium reserves would permit the installation of a power generation capacity of only around 15,000 MWe. On the other hand, the deployment of plutonium in fast breeder reactors—along with Uranium-238 in the depleted uranium discharged from PHWRs—would permit much better exploitation of the energy potential in uranium, and a power generation capacity as high as 3,50,000 MWe, is technically possible.

In the overall energy strategy for the coming decades, the fast breeder reactor will effectively serve to bridge the time gap between the currently available energy technologies and the more distant technologies like nuclear fusion.

Liquid metal-cooling

The best developed type of FBR is the liquid metal-cooled fast breeder reactor (LMFBR), using liquid sodium as the coolant. Prototype power reactors of this design have been in successful operation in France, the Soviet Union and Britain for many years. Following the very satisfactory experience in the operation of the 250 MWe Phenix power reactor, the construction of a commercial sized 1,200 MWe LMFBR (Superphenix) has been completed in France and the reactor will go into operation in 1985. In the Indian programme, a major step was taken in adopting the design of the French experimental fast reactor, Rapsodie, for setting up a Fast Breeder Test Reactor (FBTR) as part of the Reactor Research Centre at Kalpakkam. This centre, established in 1971, is primarily devoted to the development of all aspects of the science and technology of fast reactors.

Different design

The design of the reactor core and the nuclear steam supply system in an LMFBR differs from that of a PHWR in many respects and details. The fuel charge in the FBR consists of plutonium-fuel subassemblies, supported vertically on a grid plate inside the reactor vessel. Each subassembly is made up of a bundle of fuel pins of stainless steel clad tubes, charged with fuel pellets composed of a mixture of plutonium and uranium ceramic material. Surrounding the fuel core, both axially and radially, are blankets containing fertile material. Reflectors and shield subassemblies surround the radial blanket.

The choice of liquid sodium as the coolant is based on its excellent heat transfer characteristics, good chemical compatibility with both fuel and stainless steel, and the wide temperature range that it offers for reactor operation on account of the large difference between its melting point (98°C) and its boiling point (882°C). In a typical system, liquid sodium coolant (at around 400°C) is pumped into the reactor by primary sodium pumps to flow through the subassemblies. As the hot primary sodium exiting the reactor core (at around 550°C) will be radioactive, it is not used directly to produce steam. The heat is transferred to a secondary sodium circuit through the agency of intermediate heat exchangers and the secondary sodium is pumped through specially designed sodium heated steam generators, to produce high pressure superheated steam for power generation. This integrated scheme is schematically shown in the Figure. (See page 87)

The LMFBR can be either of the loop design—where the primary pumps and the intermediate heat exchangers are located outside the reactor vessel, as in the case of Rapsodie and FBTR—or it can be of the pool type, where the entire primary sodium circuit is located around the core inside the reactor vessel, as in the Phenix and Superphenix reactors. The reactor vessel is closed at the top by a heavy roof slab which houses rotatable plugs for the loading and unloading of subassemblies, and also serves as a biological shield at the top of the reactor. The power level in the reactor is controlled by movement of boron carbide control rods. Instrumentation including neutron detectors, thermocouples and flow meters is provided to monitor power level, sodium temperatures and the flow of sodium.

With its accent on the use of plutonium in concentrated form as the fuel and liquid sodium as the reactor coolant, and operation at relatively high temperatures, the LMFBR represents a high level of sophistication in technology.

On account of the extreme toxicity and the alpha radioactivity of plutonium, all operations involving plutonium have to be effectively contained and the various steps of fuel fabrication have to be conducted in hermetically sealed glove boxes. To avoid the accidental assembly of critical masses, the operations have to be confined to small batches. In view of the high cost of plutonium and its fabrication, and in the interest of the

economics of the overall fuel cycle, a much better burnup in a single cycle is required in fast reactor fuel performance. (A desirable burnup will be of the order of 100,000 MW days per tonne of fuel as compared to less than 10,000 MW days per tonne in the PHWRs). This calls for a very close control of chemistry and microstructure in the production of plutonium-uranium ceramic pellets, and for great care in their encapsulation in the stainless steel fuel tubes. The higher concentration of plutonium and the larger accumulation of fission products during reactor irradiation require special consideration in the design of process and equipment for the reprocessing of fast reactor fuel.

While liquid sodium is attractive as a heat transfer medium, it is also chemically reactive. The hot metal will burn freely when exposed to air and it can react explosively when it comes into contact with water. Unless a high purity is maintained in the coolant circuit, liquid sodium can corrode even stainless steel. The design and operation of the fast breeder reactor have to reckon with these various factors. An essential feature of the design is that double containment is provided for the primary sodium circuit and argon gas is provided as the blanket to protect the metal from oxidation. In the sodium heated steam generators, very sensitive techniques are employed for the prompt detection of any incipient failure of the water tubes, so that the sodium and water lines can be immediately isolated. On-line purification of sodium is provided to ensure its continuous purity particularly with respect to oxygen.

Austenitic stainless steels of special quality are used for the fabrication of the various reactor components including the reactor vessel and auxiliaries, the fuel and blanket subassemblies, the sodium pumps, the intermediate heat exchangers and the associated piping. All these components have to withstand rigorous service conditions in the environment of liquid sodium and at elevated temperatures under varying stresses. In addition, the components in the reactor core have to remain dimensionally stable under intense high energy neutron irradiation. The development of special varieties of stainless steel and the technology for the fabrication of large and intricate shapes are major aspects of fast reactor engineering.

Progress at Kalpakkam.

During the past decade, the programmes at the Reactor Research Centre, Kalpakkam, have made substantial progress. The construction of the FBTR has been completed and commissioning tests have been undertaken towards achieving first criticality. The fuel for this reactor is entirely of Indian design and of unique composition made up of 70 per cent plutonium carbide and 30 per cent natural uranium carbide that has been developed at Trombay. It has been planned to bring the reactor to its full power of 40 MW thermal and 13 MWe, in a phased manner. The operation of the FBTR will provide very valuable experience in many areas including the performance of plutonium fuels and stainless steel structural components, operation involving the circulation of liquid sodium, and reactor control. The reactor will also be an important test bed for the development of new and improved fuels and structural materials for future application.

R & D facilities

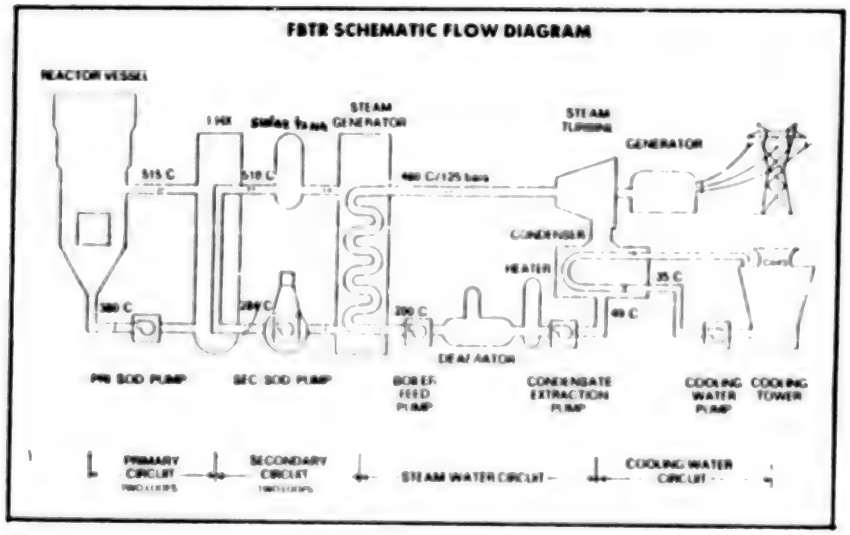
It has been fully recognised that the proper assimilation and organised development of such a sophisticated technology should be intimately linked with the establishment of a good Research & Development base of our own. Accordingly, a chain of R & D laboratories and facilities has been simultaneously established at the Reactor Research Centre, in the disciplines of reactor physics & engineering, metallurgy & materials science, radiochemistry, fuel reprocessing, electronics, instrumentation & computer application, reactor safety & health physics. These laboratories and facilities are today well equipped and are staffed by young scientists and engineers, who have acquired specialised training and experience to meet the demanding requirements of the fast breeder reactor programme. Development of equipment and instrumentation for the controlled circulation of liquid sodium, techniques for analytical control of sodium purity and for physico-chemical measurement of the properties of plutonium-uranium ceramics, high temperature mechanical property evaluation of stainless steels and special alloys in correlation with composition, heat-treatment and structure, welding metallurgy, advanced non-destructive testing techniques, and process and equipment development for fast reactor fuel reprocessing, are some of the programme areas that have received special emphasis.

A fuel reprocessing plant is also under construction at the RRC site and this will have the capacity to reprocess the uranium fuel discharged from the Madras Atomic Power Station, and also the plutonium fuel and the blanket from the Fast Breeder Test

Reactor. It is projected that, from the operation of this reprocessing plant, an adequate stock of plutonium can be generated to enable the establishment of a Prototype Fast Breeder Power Reactor (PFBR) of 500 MWe capacity by the year 2000. The Reactor Engineering & Design Group at the Centre has prepared the preliminary design report for this reactor.

In size and complexity, the prototype reactor will offer a major engineering challenge and opportunity to Indian industry. At the same time, the very satisfactory results that have been achieved in the establishment of the Fast Breeder Test Reactor, in close collaboration with various sectors of the Indian industry, should point to the optimism that this large project is well within Indian capability.

Considering all aspects, it is fortunate that India has taken the initiative to develop the LMFBR technology at the right time. The availability of this energy option is going to prove crucial to the country's development in the coming decades through the next century. The systematic development of this high level technology will also offer its own spin-offs



Potential of different power resources in India

Type	Quantity	Total Energy Potential in GW yr	Utilisation	
			Capacity in GWe	No. of years (load Factor)
Coal	90 x 10^9 Te*	26,000	500	85 (60%)
Hydro	Renewable	Renewable	100	Renewable (42 %)
Natural Uranium in PHWR (once through)	60,000 Te	340	15	30 (70%)
Depleted uranium in FBRs	60,000 Te	16,000*	350	65 (70%)
Thorium	3,20,000 Te	1,68,000*	1000	240 (70%)

* To 600 m depth and 1.2 m seam thickness. * Limited by U/th Inventory.

CSO: 5150/0021

BRIEFS

INDO-SWEDISH NUCLEAR TALKS--Bombay, April 11--Though the design of electronic equipment, system integration and manufacturing had been satisfactory on an indigenous level, the components needed for nuclear reactors had to be imported because they were either not manufactured or else did not meet the strict quality control requirement, Mr M.H.P. Rao, executive director, Nuclear Power Board (NPB), said here yesterday. Delivering the keynote address at an Indo-Swedish workshop on control and instrumentation for nuclear power reactors, organised jointly by Studswik of Sweden and NPB, Mr Rao said that it might be difficult to adhere to total indigenisation and some compromise might be warranted. However, he said Indian manufacturers should be encouraged to develop on their own or enter into collaboration with established suppliers. Mr Rao felt that it had not been possible to utilise advanced technology in the nuclear instrumentation field because of "high reliability and safety." He added that the situation was further aggravated in India because of the lack of training in new technology and location of sites. Mr S.O. Bertstrom, senior vice-president, Studsvik, speaking on the "Nuclear power programme in Sweden and Finland," said that 40 to 50 percent of the energy was supplied by Sweden's 12 nuclear reactors. However, following a referendum in Sweden in 1980 when the people were asked to choose between phasing out of reactors, completing the existing ones, and running them as long as they adhered to safety measures, a decision was taken to operate the present 12 till 2010 A.D. and not build anymore, Mr Bergstrom said. [Text] [Bombay THE TIMES OF INDIA in English 12 Apr 85 p 3]

VIETNAM SEEKS HELP IN ENERGY--Vietnam has sought India's help in the development of atomic energy. The request was made during discussions with a delegation from India's atomic energy commission during its week-long visit to the country last week. India and Vietnam have also expressed willingness to strengthen scientific and technological cooperation on the peaceful use of the atomic energy. [Text] [Delhi General Overseas Service in English 6 May 85]

NUCLEAR POWER EQUIPMENT--Tiruchi, April 8--The Bharat Heavy Electricals Limited, Tiruchi, is gearing up to meet the projected demand for nuclear power generation equipment. The first 235 MW steam generator for the Narora Atomic Power Project will be delivered on schedule before March 31, 1986 and steam generator production will jump from 1.5 to 8 a year. Addressing a press conference on the performance of the Tiruchi unit, Mr E.S. Chandrasekaran, Group General Manager, said letters of intent for the manufacture of two units each of 235 MW for Kakrapara, Kota and Karwar atomic power plants had already been received. Stating that the unit has received orders worth Rs 1425 crores for power generation equipment, Mr Chandrasekar said these orders would keep the units busy for nearly two years. Within three years of commencement, the Ranipet Boiler Auxiliaries Plant, Mr Chandrasekar said, had achieved a production of 37,500 tonnes which was 67 percent of the rated capacity. [Text] [Madras THE HINDU in English 9 Apr 85 p 9]

MINISTER ON NUCLEAR POLICY--The Lok Sabha was told that the government is concerned at the possibility of Pakistan's nuclear program having a non-peaceful dimension and the attitude of certain countries that may have the effect of encouraging this process. However, it was reiterated that there will be no change in India's nuclear policy. The minister of state for external affairs, Mr Khurshid Alam Khan, said this in a written reply. In reply to another question, the minister of state for science and technology, Mr Shivraj Patil said there have been discussions with France for mutual cooperation in various fields of atomic energy including supply of nuclear power reactors. [Text] [BK150820 Delhi Domestic Service in English 0730 GMT 15 May 85]

REACTOR TO START OPERATION--New Delhi, May 16 (AFP)--India's first breeder reactor using a homemade unconventional nuclear fuel is expected to start operation in August, PRESS TRUST OF INDIA (PTI) reported. The fast breeder test reactor at Kalpakkam near the south Indian city of Madras has been handed over to the operation group for commissioning, the agency said quoting the Department of Atomic Energy sources. The reactor, based on French design, originally was meant to use conventional uranium-plutonium oxide fuel, but India had to decide on an alternate fuel as it could not get the highly enriched uranium from France, PTI said. When the reactor is commissioned, India will be the first country using a mixture of carbides of plutonium and un-enriched uranium, PTI said. PTI quoted sources as saying that the fuel had been tested and found to be "even better" than oxide fuel, dispelling initial doubts on its effectiveness. The reactor, using sodium as coolant, will be made critical with a small core of fuel assemblies and operated at a low power level to conduct experiments in the first phase, PTI said. The commissioning of steam generators and turbines will be taken up later. When fully commissioned, the plant will generate 15 mega watts of electricity and will be the basis for designs of bigger breeder reactors, PTI said. [Text] [HK160742 Hong Kong AFP in English 0726 GMT 16 May 85]

NUCLEAR ENERGY PLANS--New Delhi, March 28 (UNI)--A perspective plan has been drawn up by the Department of Atomic Energy to increase the country's installed nuclear power capacity to 10,000 MW over the next 15 years by setting up twelve units of 235 MW and ten units of 500 MW. The science and technology minister, Mr Shivraj Patil, told the Rajya Sabha today. He said the report of the department's site selection committee for the eastern electricity region of which Bihar formed a part, was under preparation. He said a site at Kalga in Karnataka had been recently approved by the government for setting up two units of 235 MW capacity each. [Text] [Bombay THE TIMES OF INDIA in English 29 Mar 85 p 6]

PACT PROPOSAL WITH PAKISTAN DENIED--It was officially stated in the Rajya Sabha today that there is no proposal for a nuclear pact with Pakistan. The minister of state for external affairs, Mr Khurshid Alam Khan, said this in a written reply to a question. He said the Pakistan Government claims that its nuclear program is for peaceful purposes only, but the government has noted with concern reports pointing toward the possibility of Pakistan's nuclear program having a nonpeaceful dimension. The minister was asked through another question whether government proposes to change its nuclear policy. He replied that while India's policy continues to be to use atomic energy for peaceful purposes only, all relevant factors are taken into account in the formulation of policy. [Text] [Delhi Domestic Service in English 0830 GMT 9 May 85 BK]

CSO: 5100/4752

PAKISTAN

SCIENTIST DISCUSSES PAKISTAN'S NUCLEAR CAPACITY

Rawalpindi HURMAT in Urdu 2-14 Mar 85 pp 7-21

[Interview with nuclear scientist Dr Abdul Qadeer Khan in Kahuta, date not specified]

[Text] The anti-aircraft guns and missiles pointed upwards as we traveled in a car driven by a brigadier in uniform. The number of anti-aircraft guns, missiles and radars increased as I looked at the mysterious road leading to the enigmatic building where (according to the Western press) Dr Abdul Qadeer was busy making the Islamic Bomb. Hot weather had set in, but it was not hot enough to require airconditioning. Still the brigadier turned on the airconditioner. Perhaps the brigadier, like myself, was feeling the emotional heat of the environment.

The antennas of the radars were spinning fast while the gunners stood erect behind the anti-aircraft guns. They seemed to be looking for something in the sky. We could see pedestrians walking along the road, but I think they were not way-farers but were employees of the intelligence and security agencies. Then a check post came where the brigadier slowed the car. A sharp-eyed security guard looked inside the car and saluted the brigadier, and the car sped up again. Then the second and third check posts, next the region of top security, and lastly we entered the "danger zone." After a few yards the car stopped in front of the office of "the Invincible Scientist." Another brigadier waiting for us there led us to the office of Dr Abdul Qadeer Khan.

As a government servant and now as a journalist, I have had the opportunity of meeting many towering personalities, not only of Pakistan but of the world, including military rulers and prime ministers, but the excitement and suspense that I experienced before meeting this great son of Pakistan was perfectly new to me. Dressed in a deep blue suit, almost six-feet tall, Dr Abdul Qadeer stood up to greet me with his winning smile. I could not take my eyes off him. He said, "Let us sit down and have some coffee." The table was laden with all sorts of foods and drinks. He made tea with his own hands. I was studying his sweet smile and soft cultured speech. An image of good manners and dignity, he looked more like an athlete than a scientist. I was trying to size him up when Dr Qadeer said, "Please drink your coffee."

When we began to talk I saw the real Dr Abdul Qadeer Khan. Clearly, what he told me in confidence cannot be made public, but I could see that he was in a state of great emotional turmoil. He has achieved a great deal but he wants to achieve more. He talked with the dignity of a man inspired by firm convictions. I could see that like Iqbal's Man of Faith he was in a state of deep emotional stress over the pitiable state of Muslims in general and Pakistanis in particular. He seemed to be helpless in the face of the predicament in which he had to work. I talked to him for about three hours. I asked him direct as well as indirect questions; delicate as well as blunt questions, but his answers were ever patient and precise. (HURMAT and myself are grateful to the doctor for taking me into his confidence and answering my questions.) I wanted to talk to him more, hence another interview was scheduled. HURMAT is the only weekly in Pakistan that has had the honor of interviewing the doctor twice within a few days. It is the only weekly that has been permitted to take his photographs. In the past only one of his pictures (which had been taken during his stay in Holland) has been published in the Pakistani press. The new pictures were not to be published for security reasons, but we are grateful to the doctor for allowing us to take them.

Dr Abdul Qadeer is the symbol of Pakistan's astounding progress in the field of atomic energy. Dr Abdus Salam, before him, startled Western minds by winning the Nobel Prize for physics, and now Dr Abdul Qadeer's successful research has surprised the world. Dr Abdul Qadeer is one of the handful of truly great men we have in the country. The pride of Muslim scientists, Dr Abdul Qadeer is basically a mineralogist. But, besides minerals, he gives special attention to the study of physics, electronics and the working of machines. He is an expert in all the sciences which are essential to achieve success in the modern age. What makes his achievement outstanding is the fact that he comes of a simple middle class family and has become a world renowned scientist by his own personal efforts. He could, like millions of other Pakistanis, pass his life merely as the inspector of weights and measures in Karachi. But maybe he read Iqbal's poem "Sultan Tipu's Testament" with great attention and consequently turned his "small stream into a stormy river." Many obstructions must have stood in his way. The giants of despair and discouragement must have tried to dishearten him too. But it is a fact that he who borrows light from his own inner self never fails to shine.

Now let us talk about that achievement of Dr Abdul Qadeer for which he was first made a target for litigation in the Netherlands and then a victim of brain-washing. The most important part of atomic fuel is the enrichment of uranium. This is something that took countries like Britain, Germany and the Netherlands 25 years with the help of many scientists, after spending thousands of millions of dollars. A developed country like Japan has managed to construct a small pilot plant after spending $640 million. America is erecting a cetrifuge plant in Portsmouth, Ohio at the cost of $10 billion which will start working in 1989. Contrary to them all, Dr Abdul Qadeer has found a method of enriching uranium at very little cost in a very short time. People of the West are concerned about Dr Abdul Qadeer's achievement for two reasons: 1) If it is possible to enrich uranium by a low-cost formula,

why are they spending so much money on it? 2) They are frightened at the prospect of the Muslims learning the very secret that they have been trying their utmost to keep hidden from them.

Like a good Muslim Dr Qadeer attributes all his outstanding achievement to the grace of God. He is grateful to his wife for giving him the peace of mind essential for doing sustained work, and thanks his colleagues, without whose devotion and tireless work he could not have achieved much. His valuable life, the pride of the Muslims and of Pakistan, is the chief target of attack for the enemies of the Muslims and Pakistan. All of us know how Yahya Almashhadi, the prominent nuclear scientist of Iraq, was murdered in broadday light in the Hotel Maridian of Paris. Those murderers must be making schemes for destroying Dr Abdul Qadeer, too, But I am sure he will remain alive and active with the good wishes of the one billion Muslims of the world.

After a careful scrutiny of the situation, I can say that though the security of Kahuta is satisfactory, I am not satisfied with the measures taken to protect this great personality of Pakistan. Dr Abdul Qadeer is perhaps the only person who has added to the honor of Pakistan in Asia. Because of his achievement every Pakistani can hold his head high. That is why our enemies would be glad to do away with him. When he goes from Islamabad to Kahuta in his bullet-proof car, security cars go before and after him until he reaches his office safely. His office is protected too, but there is no satisfactory arrangement for the doctor's personal security. When he goes to Karachi, according to information I obtained, he is exposed to danger. When during the interview the doctor opened his brief-case, I could see a shining revolver in it, but what is the use of a revolver against the latest automatic weapons and missiles fitted with telescopes? I suggest that stricter measures be taken for the security of this world-famous scientist. I am making these suggestions because HURMAT received information 2 months ago that pointed to a danger to both the doctor and Kahuta. It is a mistake to suppose that the situation has changed after the death of Mrs Indira Gandhi. A HURMAT team is busy preparing a title story from the information received from different sources. HURMAT's issue of the first week of April will disclose where the danger lies.

After two long meetings with Dr Abdul Qadeer I have come to the conclusion that, like President Ziaul Haq, humility and modesty are his most prominent traits of character. He has a relaxed personality. I personally think that he has not received the honor and recognition that he deserves for discovering the process of enriching uranium for peaceful purposes. Both the government and the people are to blame for it. True, an association in Lahore has given him a gold medal, but is that all he deserves? I think that the president should, in a special meeting of the federal cabinet, heads of the armed forces, chief justice of the Supreme Court, the provincial governors and other dignitaries of the country, bestow on the doctor the highest decoration of the land. Why is Pakistan, where every Tom, Dick and Harry is getting medals, ignoring the man who has helped his country to join the ranks of the scientifically developed countries of the world? Another

suggestion I want to make is that in order to overcome the energy crisis in the country, the out-dated Pakistan Atomic Energy Commission be overhauled and its leadership be given to Dr Abdul Qadeer, who is Iqbal's Man of Faith. At present the said Energy Commission is nothing more than a white elephant. We cannot expect this commission to solve Pakistan's energy crisis. It needs an overhaul. Dr Qadeer has made Pakistan an atomic power. He has performed a miracle that could not even be imagined in a third world country. He is a brave and patriotic man with a lot of knowledge and experience. He is managing Kahuta project with its thousands of workers with great ability. I am certain that if he is given the control of a board comprising the Pakistan Energy Commission and other related departments, he will manage it with great ability and take it to great heights. Under his care this department will set up atomic power plants all over the country and bring atomic energy within the reach of every one. This is the need of the time and the only solution to our energy problem.

(Dr Abdul Qadeer interviewed by editor of the HURMAT in his office at Kahuta, time not specified.)

[Question] What is the "Dutch Scandal"?

[Answer] This is the law suit the Dutch government brought against me. They got a bad name because they indicted me without giving me a chance for self-defense.

[Question] What has become of the appeal you entered against this unilateral indictment?

[Answer] You know the law-suit was brought against me without my knowledge. I came to know about it only two days before it was to be settled on 14 November. I sent two telegrams to the Dutch law court, which they received but still they indicted me out of malice. I have made an appeal against that indictment. Two famous Dutch lawyers and two Pakistani lawyers, S.M. Zafar and M.B. Zaman, will be appointed to fight my case in the law court. Other great lawyers from England, Germany and France who have knowledge of international law have been consulted in this matter. All of them say that this law suit is based on malice and ill-will and has no status according to international law. Last year when my appeal was read for the first time, the public prosecutor's demand for my arrest was rejected by the high court. A second hearing of my case will take place on 14 March. My Pakistani advocates will then be present in the court. My Dutch advocates have informed me that the public prosecutor will ask the court to send the case back to the lower court, since many laws had been broken during its hearing at the lower court and during the preliminary investigation. If we had not presented an appeal, the public prosecutor would have been very pleased to get me indicted unlawfully and maliciously. I am sure the Dutch high court will do justice in this case, since the Netherlands is famous for justice all over the world. Why should anybody be punished for misconduct by some low-grade officials?

[Question] Will you please tell me how and when you thought of serving your country with your knowledge and experience in your special field. Did

you make a proposal to the government, or did the government take the initiative?

[Answer] When I went to Europe for higher studies I intended to come back to work in Pakistan. I took the subject of metallurgy partly because in Pakistan there are very few experts in this field, and partly because we cannot make progress in industry without learning this subject. I kept visiting Pakistan even when I was in Europe.

I intended to return as soon as I got a chance of working here. I came to Pakistan at Christmas of 1975 and fell ill. My family persuaded me to stay in Pakistan. I found a good job in the Ministry of Finance where I directed many technical projects with the help of my special skills. I was offered the management of this project during those days. My first project proved to be a great success and I completed it with the help of a team of very good co-workers. It was the result of the hard and selfless work of my colleagues that Pakistan is today one of the five or six nations of the world with know-how in the enrichment of uranium. We are very grateful to President Ziaul Haq, and Finance Minister Mr Ghulam Ishaq Khan for the encouragement they gave us. They will go down in history for the help they have given us in our work.

[Question] We have heard the name of Kahuta only recently, but it is said that you started working on the project long before the newspapers ever wrote about it. Please tell me how you kept the project secret from the public eye for so long and also tell me how the work was started.

[Answer] As you know, the Western powers do not want any developing nation to become so highly developed as to become independent of their help and patronage. Hence, when we started this project at the end of 1976 it was decided to keep it secret until we had procured all the necessary equipment. The site of Kahuta was selected at that time. I requested the government to give us the services of the Engineering Corps of the land army so that the work could be done with speed. The president as the commander-in-chief of the army gave the services of a very active and competent team under the leadership of Brigadier Zahid Ali Akbar Khan (now lieutenant general and corps commander). We explained our needs, to them, and first General Zahid and then General Anis got the plan completed, and none of our enemies came to know about it. By then we had prepared the designs for all the things we needed for the project. As you know when a big project is started, first of all a "feasibility report" is prepared. Then models are prepared on the laboratory scale, and then the pilot plant is built. Only after that, work is started on the industrial level. This was the first plant on which everything was started simultaneously. On one hand the plant was under construction and, on the other, we were making experiments on the laboratory scale. We had decided to make Pakistan one of the foremost countries in this field, and with the grace of God we have succeeded in our mission. We have completed the project in record time. We were in great trouble in the beginning, since no country was willing to give us the technology we needed. On the otherhand if any other countries had discovered what we were trying to achieve they would have made life unbearable for us. When our secret was

discovered, President Carter stopped our aid, and the whole of the Western world as well as India began to attack us like jackals. Our enemies were defeated because my colleagues and I had made everything in our own country. Now, if needed, we can build 100 plants like Kahuta in Pakistan. We are proud of the fact that we have created in 6 years and without much expense a technology that the Western countries discovered in 30 to 35 years after spending billions of dollars. We can conclude that Pakistanis can achieve everything if they work with sincerity and determination.

[Question] Can you compare the Kahuta project with the nuclear capability of developed countries like, let us say, Britain and France?

[Answer] In the enrichment of uranium, Pakistan is equal of the United States, Britain, the Netherlands and Germany. We are ahead of Japan and India in this field. Thus my colleagues and I can claim that we have done our duty in this field.

[Question] Being a Pakistani, I would like to know what our position is as compared to that of India as far as nuclear capability is concerned.

[Answer] As I have said before, we are ahead of India in the matter of the enrichment of uranium, and India will not be able to compete with us for many years to come. But in other fields, e.g. reactors, heavy water, fast breeder reactors and reprocessing, India is ahead of us and we shall have to work very hard in those fields.

[Question] Is it enough to enrich uranium in order to get atomic energy? How can this technology help us when we have no nuclear power plants?

[Answer] Nuclear power plants are needed if we want nuclear energy, but these plants cannot work without nuclear fuel. If we have nuclear plants but no nuclear fuel the result will be exactly what happened at the nuclear plant at Karachi. Our enemies stopped giving us fuel and as a result the plant stopped working. Now we have decided that no power is going to humiliate us in the future. That is why we have arranged for the nuclear fuel first. Now when we get a new power plant we shall work it with our own atomic fuel. Building reactors is not a part of our duties or I assure you we would not disappoint the nation in that respect.

[Question] Though the government of Pakistan has announced time and again that they have not interest in making an atomic explosion, I just want to know if the enrichment of uranium has given us the capability for making such an explosion?

[Answer] The president and I, myself, have announced again and again that our atomic program is meant for peaceful purposes only. We want to help in the welfare of our country. Still people go on talking against our atomic program. My colleagues and myself have the capability for doing everything for the protection of the country's security and ideology, but all we want to do is to help in the progress and prosperity of our homeland.

[Question] You once said in an interview that, if the president were to decide, you would not disappoint the nation. Please explain that.

[Answer] Well, I mean exactly what I said. You must have heard the political leaders declare that, if ever the defense of the country's security and integrity requires, they would sacrifice their lives for it. That is exactly how the scientists and engineers of the land think, too. I meant to say that if the president gives the order to protect the country with the help of our special capability, we would sacrifice our lives and fulfill his orders.

[Question] Suppose the government tells you in the beginning of March that an atomic explosion has to be made on 14 August. Have you got the technical capability to fulfill this order within the next 4-5 months?

[Answer] You are giving us too little time. Even a baby cannot be born in such a short time. It takes longer than that to sink a tube-well. We should not make a joke of the matter. The president has often announced it, and many countries including the United States have come to believe that our atomic program is meant purely for peaceful purposes. We have no intention of using atomic technology for any other purpose.

[Question] Some people say that Pakistan has already made the atom bomb. They say that when uranium is enriched for making bombs no experimental atomic explosion is necessary. Is it true?

[Answer] All this is mere gossip. Our program is meant only to meet the ever-increasing need for electricity in our country. As for the question of an experimental atomic explosion, there is no difference between plutonium and enriched uranium. There are a few basic experiments which, with present-day technical expertise, help one to determine whether one is in a position to make an atomic explosion. For example, Japan, Germany, the Netherlands, Sweden and Switzerland are all in a position that even without conducting an experiment they can make an atomic explosion when they need it. They have all that they require to make an atomic explosion.

[Question] The country has been in great trouble owing to a shortage of electric power. When will your atomic capability start working for the country?

[Answer] At present we have only one atomic power plant in Karachi, with a capacity for producing 130 megawatts of electricity. Owing to a scarcity of atomic fuel, it could only produce 30 megawatts. Now maybe it is producing a little more. Had a thermal station not been started at Karachi, the people there would have been in exactly the same predicament in which the people of Pindi and Islamabad find themselves. Our government has been inviting tenders for the establishment of an atomic power station but to no avail. Even if a tender does come and is accepted the power station will start working only after 10 years. By that time conditions will have become worse than they are today. It is better, even essential, for us to start some thermal stations and overcome the scarcity of electricity in the

country. It is a great shame and a proof of our incompetence that our capital, where the representatives of all countries reside, is always sunk in darkness at night. If we start a thermal station at Islamabad it will not mean much work and will not take much time. In this way the representatives of other countries, who are our guests, will not get an impression of our incompetence. I really feel ashamed when power goes off at night.

[Question] The federal minister of planning said recently that no Western power has offered tenders for building an atomic power station at Chashma, because the United States is using its influence against Pakistan. Can Pakistan not build this power station by its own efforts, or with the help of friends like China?

[Answer] No tenders have come for the Chasma power plant and none will come. We are deceiving ourselves when we think that someone will help us. No Western country will give us reactors unless we slavishly accept all its conditions. As I said before, even if we do conclude a contract with some country to build a power plant, the benefits will not start coming before 10 years. Our needs are urgent. We should have started work on our own reactor as soon as Canada stopped the supply of atomic fuel in 1974. During the last 11 years we could have learned to build reactors that could produce 100 MW of electricity. If India and Korea can do it why cannot we do something that requires only an elementary knowledge? We have wasted a lot of time. Our country has many excellent scientists and engineers who, if given an opportunity to work, will not disappoint the nation. China, according to press reports, is working on a 300 MW reactor. I am sure they will be successful, as they are an industrious nation and believe in being self-sufficient. China is our friend, and now that it has become a member of IAEA [International Atomic Energy Agency], we can, according to a pact, join them in building reactors for peaceful purposes.

[Question] Britain's DAILY TELEGRAPH has written that Pakistan has the capacity to make six atom bombs annually. Does the capacity for making six bombs mean that we have made some progress in the atomic field?

[Answer] Building six or even sixty bombs is not proof of progress in any way. We have to judge how a country uses this capacity for the welfare of its people. Take the example of India. They made their first atomic explosion in 1974, but, even after 11 years, millions of their people sleep on the footpaths, and the trucks of the country come in the morning to collect their dead bodies. What is the use of such capacity that does not help us to feed and house our poor? Our atomic program is geared to peaceful aims and the nation will soon see the results.

[Question] Is Pakistan self-sufficient in uranium and other atomic minerals? Can we export purified uranium?

[Answer] The Pakistan Atomic Commission is in charge of the work being done on atomic minerals. According to their report Pakistan is self-sufficient in this matter. I can say nothing about the export of enriched uranium. The government will decide about it. At present the enriched uranium will be

saved for our own use. This will make us self-sufficient in atomic fuel when we (with God's help), set up our own reactor. Enriched uranium is very costly; 3-percent enriched uranium, which is used in the reactors, costs about 25 million rupees per ton.

[Question] The Western media say that China helped Pakistan in its atomic program. How far is that true?

[Answer] The Western media want to give China, our best friend, a bad name. They also want to prove that we are quite incompetent. If you study the facts, you will find that neither Britain nor France was helped by the U.S., nor was China helped by the Soviets, to become an atomic power. Atomic technology is not a car factory or a flour mill that could be exported from one country to another. Every country has been very responsible in this matter. Only the Soviets, in their enmity for China, helped India to become an atomic power. But for the Soviets, India could not have made the atomic bomb for a long time to come.

[Question] A few months back Mr Sethna, the former chairman of India's Atomic Commission, stated that Pakistan could not have made any progress in this field if China had not helped it.

[Answer] These shop-keepers think Pakistanis are inferior to them. Allamma Mashriqi, Professor Salimuz Zaman Siddiqi, Professor Raziud Din Siddiqi and Pro Salam have disproved their boast. These Pakistanis rank among the foremost scientists of the world. We have great ability and we have done the job by our own efforts. It sounds childish, but if Mr Sethna would try to compete with me in the presence of a team of experts, I would show him which of us has greater knowledge in this field. I am sure he will not even be able to stand before one of my colleagues.

[Question] The Western mass media seem to be suffering from the phobia that if Pakistan makes the atom bomb, it will be passed on to other Muslim countries and will ultimately be used against Israel. Why do they fear, it, and why do they think the Kahuta project is getting monetary help from some Muslim country?

[Answer] Western countries are not above making false statements to serve their own purposes. You realize it every 3 years when their secret papers are made public. One is astonished at the lies that even their responsible officials tell. The reports about the sinking of the Argentine ship "Belgrad" is a case in point. As I said before, atomic technology is not a method of growing food-stuffs that you could export to another country. Our program is meant for peaceful purposes, and there is no question of our making or exporting atomic bombs to other countries. Pakistan will continue to cooperate with other Muslim countries under the supervision of an international commission. As for Kahuta, it has been built entirely by our own men and money. I can tell you that we have completed this job with less time and money than any other country in the world.

[Question] U.S. Senator Allen Cranston, speaking on international terrorism, expressed the fear that all Islamic states would join Pakistan in its atomic program. Why is he so scared about it?

[Answer] Senator Cranston has the wrong impression that Pakistan will serve up atomic technology to another country on a platter. This senator, who is under Jewish pressure, is considered their representative. That is why he is always foremost in all pro-Jewish movements. Israel has lost the sympathy of the world by its aggressive policies, but when this senator cries "wolf," he generally succeeds in getting help from the Western countries for Israel.

[Question] What is your impression as a Pakistani citizen and intellectual about our country having the Soviets as antagonists and the Western powers suspicious of us because of our atomic program?

[Answer] The situation is certainly dangerous. On the one hand, the Soviets have aggressively occupied Afghanistan and their close relations with India are a danger for us. Continuous attacks on our borders to harass us are part of the anti-Pakistan policy of the Soviets. On the other side, our so-called friends in the West are always criticizing us for our atomic program. Their media are engaged in a pernicious propaganda campaign against our nuclear program.

[Question] When will the nation see the fruits of the Kahuta project managed by a great scientist like you? The nation has lost faith in most others, but we will believe in what you say.

[Answer] It is true that people have lost faith in the self-styled engineers and scientists, who only come on the scene to make speeches, write articles, give a few facts and figures, have a good time and then leave without having achieved anything for the nation. My colleagues and I have discovered a way of making atomic fuel, which will help the nation to save a lot of foreign exchange. If the government ever decides to sell atomic fuel or the technology, they can earn millions of rupees for it. At present we are saving the fuel for our own future needs.

[Question] A few weeks ago India's Prime Minister Mr Rajiv Gandhi said that if Pakistan builds atomic weapons, India will have to revise its own policies.

[Answer] This is mere hypocrisy of these shop-keepers. When India made an atomic explosion 10 years ago, was it merely a game of fireworks on Diwali? I know, and hardly anybody will disagree with me, that India has been preparing atomic weapons during the last 10 years. They blame us only to deceive the world. Neither Nehru nor the Gandhi family is trustworthy. The late Mr Gandhi, Nehru and Mrs Indira Gandhi are notorious for the contradiction between their words and deeds.

[Question] Do you and your colleagues have the capability for building an atom bomb?

[Answer] If I give a direct answer I will be misunderstood. Hence I will explain: When an architect sees a building, he scrutinizes it and tries to

think if he can make a similar design. When a mechanical engineer sees a machine, he tries to figure out how the machine works and tries to think if he can make it himself. My colleagues and I have studied all that has been published about atomic weapons. We have often discussed it and come to the conclusion that what the United States achieved 40 years ago and India achieved 10 years ago is not beyond our abilities, especially when we achieved the more difficult object of the enrichment of uranium. We will meet with hurdles but they will not be unsurmountable. But as our government wants the atomic program to be peaceful we have to keep it peaceful...

[Question] Everybody is astonished at the fact that a metallurgist like you has achieved so much in the atomic field. What is your secret?

[Answer] I am not only a metallurgist, but a physical metallurgist, which is very important in industry. Physical metallurgy deals with the study of the formation of different metals, and their technical usefulness. It studies all the metals on earth including uranium. That is why metallurgy is considered to be the backbone in every industry. Everybody knows that, in advanced countries like the United States, Britain, France, Germany and the Netherlands, metallurgists have proved their worth by achieving the success of projects that had international bearing. One of them is the British physical metallurgist Sir R.B. Nicholson, who is at present chief physical metallurgist, Sir Allen Catrell, was chief scientific advisor to the British government. He did memorable work on reactors. A physical metallurgist is directly connected with every other technical and scientific field. His knowledge and experience are panoramic. That is why a physical metallurgist has to work harder than anybody else. I have succeeded in the enrichment of uranium, because I have been a physical metallurgist for the last 15 years. But on the whole the honor should go to my fellow engineers and scientists who worked with me night and day to achieve this success.

[Question] Dr Usmani was a good atomic scientist. Under his care the country made great progress in this field. He organized the atomic power plant at Karachi and the Nuclear Institute of Nilore. The Atomic Energy Commission has not done anything worthwhile since 1972. On the other hand, the atomic power plant at Karachi, after remaining closed for many years, is now producing at about 20 to 25 percent of its capacity. Let alone working for health or agriculture, [the commission] is not even producing electric power. What do you think about it?

[Answer] The Atomic Energy Commission is a separate department and only those in charge can make a statement about it. Or you as a journalist could study the matter yourself.

[Question] People of many countries work in the offices of the International Atomic Energy Agency in Vienna. Does this office employ experts or do people become experts after they have been working there?

[Answer] There is a general misconception about IAEA being a sort of department of the experts. It is nothing of the sort. It is nothing more than a supermarket, which has one manager, and every department has a

supervisor. Just as the manager in the supermarket has to keep an account of the goods in every department, so the director general of IAEA has to keep an account of the number of generators working in each country and the number of factories connected with atomic industry. It is just like the supervisor of a supermarket who keeps the records of all the goods that have been sold. As the person who controls the arrivals and departures of the planes at an airport is not an expert at building airplanes, in the same way the supervisors of the different departments in IAEA have to record how a reactor worked in a certain country, and how much atomic fuel was used. It is, pure and simple, a clerical job for collecting facts and figures. People working here are not experts either on the subject of the atom or on atomic technology. It is a political job. If the government of Pakistan decides to send you there as a representative they cannot refuse to employ you.

[Question] You have international fame in the field of atomic energy. The success of the Kahuta project and the president's statement in an interview given to a British newspaper, saying that Pakistan has achieved the know-how to enrich uranium, prove that you are an expert in this field. If you were to be sent to Vienna to represent Pakistan do you think you could do anything useful for the country?

[Answer] As I said before, there is nothing but clerical work to be done there. You sit in an office and collect facts and figures, and occasionally go to observe some atomic constructions in other countries. The officers spend most of their time attending parties which is against my nature. I am used to doing technical work in the plant, and I am quite satisfied with my job. This work is a challenge to us and I have accepted the challenge. Your heart would be warmed to see how diligently my colleagues work.

[Question] What work, besides enrichment of uranium, would you like to do?

[Answer] The government knows all about our abilities and faults. Whatever duties we are given will be fulfilled to the best of our abilities. We will not rest before we have completed our work.

[Question] Pakistan has invited tenders for the construction of the Chasma power plant which will generate 900 MW of electricity. I think it is not in our interest to have one power plant of so much strength. Everybody knows that atomic power plants cannot work continuously, and have to be stopped after a few weeks. Imagine what will become of the factories that will be running off power from that plant. We have a shortage of power in any case, and when this power plant stops, we shall not be able to find a substitute. That will lead to a lot of trouble. What do you think about it?

[Answer] You are neither a scientist nor an engineer, but you seem to be wonderfully well-read in this field. It is a fact that our national circuit has so little electricity that 900 MW will not make any difference. You know that the power problems of the public in Karachi were solved only when a thermal station was built there. It is better for us that, rather than have one power station of 900 MW, we should set up four or five stations of 200 MW in

different parts of the country. Even when one or two of them stop working, there will be no power crisis in the country. This is my personal view and other people may not agree with me. Moreover, we should learn to build our own power plants. If India can do it so can we. We cannot blame others for our own shortcomings.

[Question] It has been said that the choice of Kahuta as the site for an atomic plant was a mistake by the previous government. This place, it is said is insecure because it is within easy reach of India. Can not a better place be found for it?

[Answer] The site of Kahuta was not chosen blindly, nor are such decisions made by one individual. When it was decided to shift the capital from Karachi to another place, the choice of the place where Islamabad was founded was not made in a day. Nor was the choice made by one individual. The choice of Kahuta, too, was made after a great deal of deliberation. We made a survey of many places, and went to many places by helicopter. Many times, high-ranking defense officers accompanied us. We compared many regions and, at last, Kahuta was chosen.

[Question] What were the reasons for choosing Kahuta rather than any other place?

[Answer] Well, firstly, we wanted this project to be set up near an airport, since we were in a hurry and wanted the necessary things to reach us by air rather than by sea. We wanted a place where transport was easy and utilities like water and electricity were available. We wanted to be near a big city, so that the scientists and engineers could live there, and their children could get an education. For all these reasons Kahuta was thought to be the best site for the project. We wanted to be near the capital because in our work we needed the government's help continuously. This place is proper even for security reasons.

[Question] What other places were considered and rejected?

[Answer] There were many such regions.

[Question] You say that Kahuta is a proper place even for security reasons, but an Indian journalist has disclosed that according to former Chief of Staff Air Marshal Anwar Shamim, who said it to some Pakistani newsmen, Pakistan could not defend Kahuta since India could reach it in 3 or 4 minutes. The air marshal had further criticized the previous government for setting up an atomic plant in such a vulnerable place. But you say that it is a proper place even from the point of view of security.

[Answer] Kahuta is not an undefended place for anybody to grab. In the words of Foreign Minister Sahabzada Yaqub Khan, if Kahuta is attacked it will mean open war, and Pakistan has the strength to repulse such an attack. Our president, who happens to be the head of the army and has 40 years of experience behind him, knows how to defend the country. I, as the director of the project, have nothing to fear since the president knows the importance

of the project and has made every arrangement for its defense. You should not worry about it. As for the question of the Indian air force's being able to reach it in 3 to 4 minutes, tell me if there is any place in Pakistan that the Indian air-force cannot reach in a short time? Pakistan is large in area but it is not wide. Did not, during the last two wars, Indian air-forces bombard Lahore, Peshawar and Karachi? In the same way, no important city of India was out of reach of the Pakistan air-force. If they bombarded our targets, we bombarded theirs. As I have said, it will mean open warfare.

[Question] The bureaucracy in Pakistan has a bad reputation. Everybody complains that these people do not let anything move forward. Do the bureaucrats cause delay in your work?

[Answer] No. Ours is a federal project and everybody cooperates with us. We have no complaints against anybody. We are grateful to President Ziaul Haq and Finance Minister Mr Ghulam Ishaq Khan who have always cooperated with us. Without the patronage and personal interest of the president we could not be where we are today. The bureaucracy has never stood in our way.

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CSO: 5100/4744

PAKISTAN

NUCLEAR ENERGY NEEDS DISCUSSED

GF092035 Karachi MASHRIQ in Urdu 7 May 85 p 3

[Editorial: "Pakistan's Nuclear Energy Needs"]

[Text] The chairman of the Pakistan Atomic Energy Commission, Dr Munir Ahmad Khan, while addressing the annual session of the Japanese Nuclear Industrial Forum said that the pact which was signed in 1970 for the non-proliferation of nuclear arms has not served its desired purpose. Just the opposite, it has adversely affected the economies of countries with insufficient energy. The basic aim of this pact was to promote the peaceful use of nuclear energy and halt the proliferation of nuclear arms; but not even one purpose has been served by this pact. Dr Munir Ahmad Khan put the blame for this on those countries which are continuing to produce more deadly nuclear weapons and on a far larger scale than before. Moreover, these countries are not willing to provide nuclear technology to the developing countries which are suffering from a lack of energy.

It is a fact that those Third World countries which have signed the non-proliferation of nuclear arms agreement have not gained anything from this. They are not even given the guarantee that no one will use nuclear arms against them. This agreement has created unjustified discrimination between the nuclear and non-nuclear countries. The way the terms of this agreement are implemented also is unfair to these countries. The need of the hour is for every country to be provided with every possible facility to engage in the peaceful use of nuclear energy, especially those countries which are suffering from an energy crisis. They should be given every possible facility to set up nuclear power plants, otherwise they will only be adding to their foreign loans and their means of livelihood will go from bad to worse.

The main tragedy with regard to the developing countries is that the developed countries have closed the doors of modern technology to them. These countries are in dire need of means of cheap energy to promote their industries and agriculture. This purpose can only be served by setting up nuclear power plants. Pakistan too is among those developing countries which must import oil and which have very limited means of hydraulic power. Pakistan is in possession of such basic means and expertise which are required for running a nuclear power plant. Its four provinces have

large-scale deposits of uranium which can meet the entire energy needs of the country for a long time. But Pakistan needs reactors to set up nuclear power plants and it is ready to buy them from any country at fair and reasonable terms. Pakistan is ready to abide by all the terms of international supervision and safeguards. The director general of the IAEA has expressed his complete satisfaction and has said that the Karachi nuclear power plant has not violated any international safeguards. But the irony is that owing to American pressure, no Western country has even offered a tender for the Chashma project. The Western countries are treating Pakistan in a most biased way. The countries with which Pakistan has been negotiating for the purchase of nuclear reactors have been informed by Pakistan that the reactor or any other material which they may supply for the Chashma project may be subjected to international inspection and safeguards. If the IAEA is satisfied that there have been no violations against the international safeguards at the Karachi nuclear power plant, then the Western countries should have no doubts and misgivings in connection with the Chashma project.

Pakistan, through the efforts of its engineers, has gained considerable expertise in the peaceful use of nuclear technology, When Canada, under pressure from the United States, stopped the supply of spare parts, the great ingenuity of our engineers kept the Karachi plant running efficiently. Pakistan has by itself gained such expertise in enriching uranium that it can keep the Karachi nuclear energy plant running without any difficulty. In addition to this plant there are eight nuclear medicine centers in operation in Pakistan, treating about 100,000 people for various deadly diseases. There are three nuclear energy centers in the agricultural sector. One can see from this how extensive Pakistan's peaceful nuclear program is and how much Pakistan is in need of nuclear technology.

Pakistan wants Western countries, the United States in particular, not to treat Pakistan in an unjustified and biased way.

Those developing countries which have acquired expertise in the peaceful use of nuclear energy should not be deprived of the needed technology. A few days ago France said that it was ignoring the U.S. pressure and was looking into the possibility of selling nuclear technology to the developing countries. Unfortunately, this very country had backed off after negotiating the sale of a nuclear reprocessing plant to Pakistan. If this country has now realized that developing countries which wish to buy nuclear equipment for peaceful uses and are willing to abide by the international safeguards should not be deprived of nuclear technology, then it should be prepared to supply Pakistan a nuclear reactor for the Chashma project. The sale of nuclear technology benefits both the buyer and the seller. However, if the developed countries keep nuclear technology to themselves and refuse to share it with the developing countries even for peaceful uses, then Third World scientists will have to use their own brains to produce the necessary material. Expertise is not given in legacy; anyone who works hard can gain this expertise. Therefore, our scientists should start research work on a large scale in the field of science and technology and thus meet the challenge posed to them in the nuclear sector.

CSO: 5100/4754

TALKS WITH FRANCE SAID BEING HELD ON REPROCESSING PLANT

Karachi DAWN in English 23 Apr 85 p 2

[Text] KARACHI, April 22: Pakistan and France have been holding discussions "off and on" regarding problems which arose between the Pakistan Atomic Energy Commission (PAEC) and the French firm for the supply of a nuclear reprocessing plant to Pakistan.

This was disclosed here on Monday by the Ambassador of France in Pakistan, Mr. Roger Duzer, while replying to questions at a meeting of the Rotary Club of Karachi at a local hotel.

The French envoy was asked to comment on the backing out of the French firm from supplying the nuclear reprocessing plant to Pakistan for which an agreement was signed a few years back.

Mr. Duzer said: "We don't dispute the right of developing countries from having access to nuclear technology for peaceful purposes. But we are extremely cautious on the transfer of nuclear technology. It is a question of transfer of advanced technology. It is a sensitive and delicate problem.

"Both governments have had discussions off and on the problems which cropped up between the PAEC and the French firm responsible for the supply of the nuclear reprocessing plant," he said.

"The question requires an in-depth analysis since safeguards of all sorts were required. Both sides hope to achieve a solution. There is wish on both sides to solve the problem in a cooperative way. However, this has not affected the relations between the two countries," he added.

Earlier in his prepared speech, Mr. Duzer said France approved of Pakistan's firm stand on Afghanistan." France has denounced the presence of foreign forces on the soil of your neighbour and continues to do so, while supporting your search for a political solution."

"We also sustain your endeavour to bring understanding and cooperation in the sub-continent. In particular, we wish all success to the South Asian Regional Cooperation (SARC) to which you are making a valuable contribution," he stated.

Mr. F. Hashim, President, Rotary Club of Karachi, earlier welcomed the envoy.—PPI

CSO: 5100/4753

BRIEFS

PAKISTANI AMBASSADOR ON URANIUM ENRICHMENT--Pakistani nuclear scientists have succeeded in enriching uranium up to five per cent, Pakistani Ambassador Humayn Khan said on Thursday, reports UNI [UNITED NEWS OF INDIA]. Addressing a luncheon meeting of the South Asia Foreign Correspondents Association in Delhi, the ambassador quoted President Ziaul Haq as saying that "We have succeeded in enriching uranium up to five per cent, but 90-per cent enrichment is needed to build nuclear weapons." An AP report on Mr Khan's address said the success makes Pakistan the first Third World country to acquire uranium enrichment capability. Asked if Pakistani scientists already have the capability to manufacture a nuclear bomb, the ambassador said: "I cannot say whether we have progressed to that extent, but as you may know, in the United States an undergraduate came up with a plan on how to build an atom bomb...so it's not so difficult to build a bomb." [Text] [Delhi PATRIOT in English 26 Apr 85 p 1 BK]

OFFICIAL ON MUTUAL INSPECTIONS--Pakistan has reiterated that it wants to use nuclear energy for peaceful purposes and as an alternative to conventional energy sources. On arrival in Katmandu, Foreign Secretary Niaz A. Naik told newsmen that Pakistan is not implementing any program to develop nuclear weapons. He said Pakistan is ready to allow India to inspect its nuclear installations provided a bilateral agreement to this effect is concluded. Pakistan is also ready to reach a bilateral agreement on banning the manufacture of nuclear weapons. He said there have been some misunderstandings by Indian leaders about Pakistan's modest attempt to acquire arms from the United States to replace its outdated weaponry. He gave assurances that Pakistan is prepared to conclude a no-war pact and a bilateral nonaggression decree with India. [Text] [Karachi Domestic Service in Urdu 0200 GMT 8 May 85 BK]

ZIA ON NUCLEAR REACTOR--President General Mohammad Ziaul Haq said he has been visiting various provinces during the last few days to meet members of the National Assembly and Senate. Addressing a news conference in Multan this afternoon, he said the main aim of his visit is to establish links with the people's representatives so that a strategy can be prepared for the next session of the National Assembly which is fruitful for the country and the people. Answering a question about producing power from nuclear technology, the president said $1.5 billion is required for constructing a nuclear reactor, although we intend to use nuclear technology for peaceful purposes. [Excerpt] [Karachi Domestic Service in Urdu 1500 GMT 14 May 85]

CSO: 5100/4756

JPRS-TND-85-010
13 June 1985

SOUTH AFRICA

NUCLEAR ENERGY AMENDMENT ACT, 1985

Cape Town GOVERNMENT GAZETTE in English 3 Apr 85 pp 1, 2, 4, 6

[Text]

STATE PRESIDENT'S OFFICE

No. 666. 3 April 1985

It is hereby notified that the State President has assented to the following Act which is hereby published for general information:—

No. 21 of 1985: Nuclear Energy Amendment Act, 1985

GENERAL EXPLANATORY NOTE:

[ ] Words in bold type in square brackets indicate omissions from existing enactments.

_____ Words underlined with solid line indicate insertions in existing enactments.

ACT

To amend the Nuclear Energy Act, 1982, so as to substitute the definition of "special nuclear material"; to delete the provision which requires the chairman of the Atomic Energy Corporation of South Africa, Limited, to be a full-time chairman; to substitute certain designations so as to bring them into line with new designations of office and departments; to provide for the appointment of an accounting officer by the board of directors; further to define the powers of inspectors; and to effect certain textual improvements; and to provide for incidental matters.

(Afrikaans text signed by the State President.)
(Assented to 15 March 1985.)

BE IT ENACTED by the State President and the Parliament of the Republic of South Africa, as follows:—

Amendment of section 1 of Act 92 of 1982.

1. Section 1 of the Nuclear Energy Act, 1982 (hereinafter referred to as the principal Act), is hereby amended—

(a) by the substitution in subsection (1) for the definition of "special nuclear material" of the following definition:

"'special nuclear material' means—

(a) uranium-233; **[and]**

(b) uranium enriched in its uranium-235 isotope; **[and]**

(c) transuranium elements; **[and]** or

(d) any compound **[thereof derived from source material]** of any of the materials referred to in paragraphs *(a)*, *(b)* and *(c)*, or of anything so referred to and any other substance or substances,

which has under subsection (2) *(a)* of this section been declared to be special nuclear material;"; and

(b) by the substitution for paragraph *(d)* of subsection (2) of the following paragraph:

"*(d)* declare—

(i) **[any compound of]** uranium-233 **[and]**;

(ii) uranium enriched in its uranium-235 isotope **[and]**;

(iii) transuranium elements **[derived from source material]**; or

(iv) any compound of any of the materials referred to in subparagraphs (i), (ii) and (iii), or of anything so referred to and any other substance or substances,

above concentration and mass limits specified in the proclamation, to be special nuclear material for the purposes of this Act.".

Amendment of section 5 of Act 92 of 1982.

2. Section 5 of the principal Act is hereby amended—

(a) by the substitution for paragraph *(a)* of subsection (2) of the following paragraph:

"*(a)* a **[full-time]** chairman appointed by the State President for a period of office not exceeding five years, on the conditions which the Minister, with the concurrence of the Minister of Finance, shall determine, and who may be reappointed;";

(b) by the substitution for paragraph *(b)* of subsection (2) of the following paragraph:

"*(b)* an official in the Department: Mineral and Energy Affairs designated by the Minister;";

(c) by the substitution for paragraph *(c)* of subsection (2) of the following paragraph:

"*(c)* the Director-General: Foreign Affairs **[and Information]**; and"; and

(d) by the deletion of subsection (5).

Amendment of section 11 of Act 92 of 1982.

3. Section 11 of the principal Act is hereby amended by the substitution for subsection (1) of the following subsection:

"(1) The corporation may delegate any power, duty or function which is by any provision of this Act, except any provision contained in Chapter III, entrusted to or imposed on it, to **[the chief executive officer or]** any **[other]** director, any committee, or any officer or employee of the corporation, or to any director, officer or employee of a subsidiary company.".

Amendment of section 14 of Act 92 of 1982.

4. Section 14 of the principal Act is hereby amended by the substitution for subsection (2) of the following subsection:

"(2) The corporation shall invest money not required for immediate use or as a reasonable operating balance, with the **[Public Debt Commissioners]** Corporation for Public Deposits, or shall dispose thereof in such other manner as the Minister, with the concurrence of the Minister of Finance, shall determine.".

Substitution of section 17 of Act 92 of 1982.

5. The following section is hereby substituted for section 17 of the principal Act:

"Accounting officer.

17. *(a)* **[The chief executive]** A director; or

(b) an officer of the corporation,

appointed by the board of directors, **[or any officer of the corporation authorized by him,]** shall be the accounting officer charged with the responsibility of accounting for all the money received, and for all payments made, by the corporation.".

Amendment of section 36 of Act 92 of 1982.

6. Section 36 of the principal Act is hereby amended by the substitution in subparagraph (iii) of paragraph *(b)* for the expression "section 36 (4)" of the expression "section 35 (4)".

Amendment of section 46 of Act 92 of 1982.

7. Section 46 of the principal Act is hereby amended—

(a) by the substitution in paragraph *(a)* of subsection (2) for the words following upon subparagraph (iv) of the following words:

"with such equipment, and carry out thereon such **[tests and]** inspections and conduct such investigations, as the inspector may consider necessary or expedient: Provided that before carrying out any such **[test or]** inspection or conducting any such investigation the inspector shall consult with the appropriate persons having duties upon the site or place in question, to determine whether the carrying out of any such **[test]** inspection or the conducting of any such investigation would be likely to be injurious to any person's health, or to cause injury to any person or damage to any property: Provided further that in the event of disagreement as to whether the proposed **[test]** inspection or investigation would or would not be likely to have any such effect, the inspector shall refer the matter **[shall be referred]** to the corporation, whose decision thereon shall be final;";

(b) by the substitution for paragraph *(b)* of subsection (2) of the following paragraph:

"*(b)* require the licensee or applicant in question, or any other person having duties in connection with or on the relevant site or place referred to in paragraph *(a)*, to permit the inspector to take away for **[inspection]** investigation the articles or objects pointed out by the inspector or to inspect the documents specified by the inspector, and to make copies thereof or to take them away for **[inspection]** investigation, or require such applicant, licensee or person, or any other person, to give the inspector information which he may possess and which the corporation requires for the purposes of any provision of this Chapter;"; and

(c) by the substitution for subsection (4) of the following subsection:

"(4) The Minister may require any applicant for a nuclear licence, or any licensee, or any owner or person in control of any site or place referred to in subsection (2) *(a)*, to pay, within the period specified by the Minister, such fees to the corporation as the Minister may from time to time, with the concurrence of the Minister of Finance, determine, in connection with **[tests and]** inspections **[which are]** carried out and investigations conducted in terms of this section.".

Amendment of section 47 of Act 92 of 1982.

8. Section 47 of the principal Act is hereby amended by the substitution in subsection (13) for the word "functions" of the word "powers".

Amendment of section 49 of Act 92 of 1982.

9. Section 49 of the principal Act is hereby amended by the substitution for paragraph *(b)* of subsection (1) of the following paragraph:

"*(b)* dispose of **[or use]** any source material;".

Short title.

10. This Act shall be called the Nuclear Energy Amendment Act, 1985.

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END

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